Computer Modeling · Lots on Games · Electronic Tar Baby

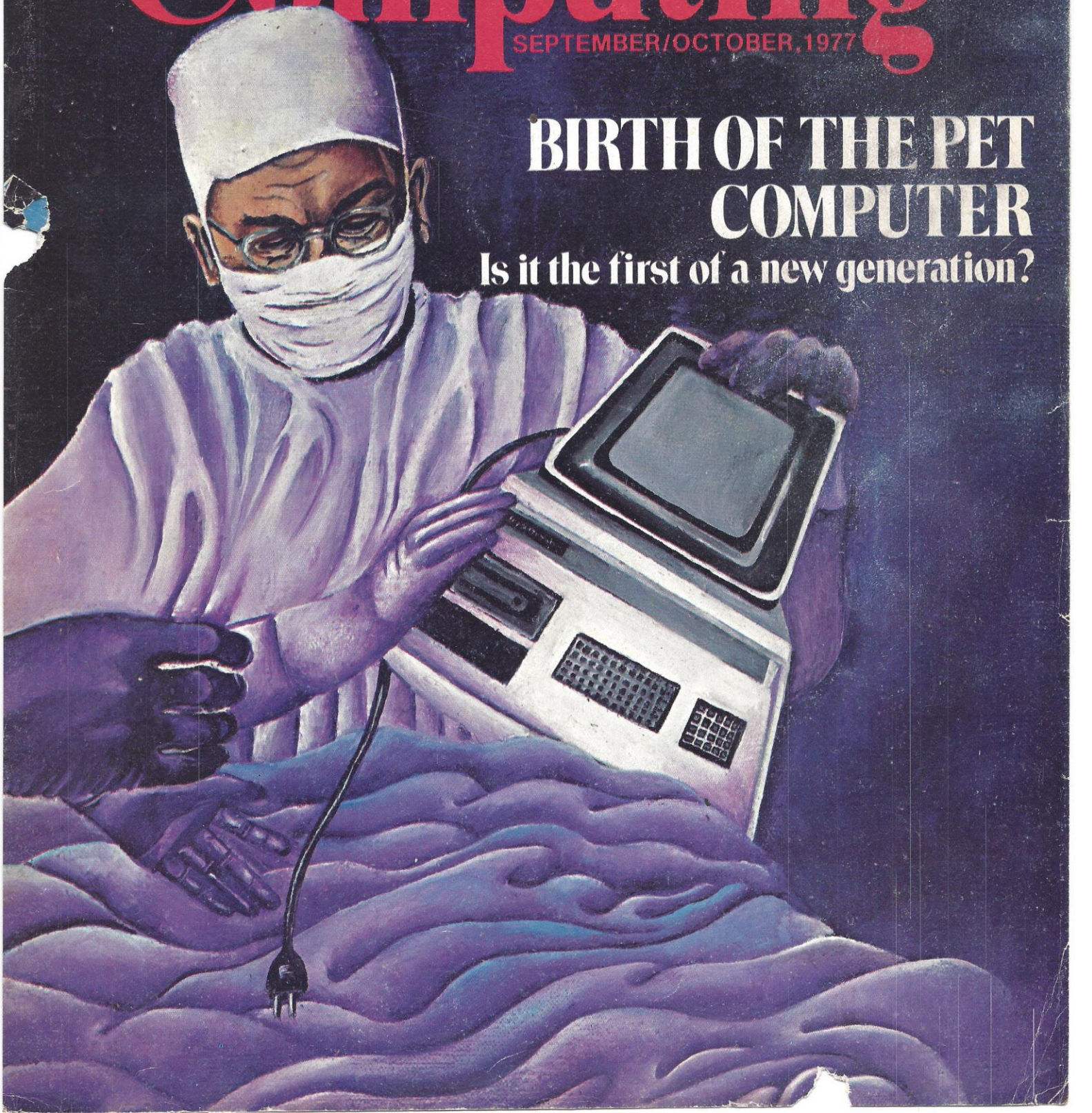
Personal Computing

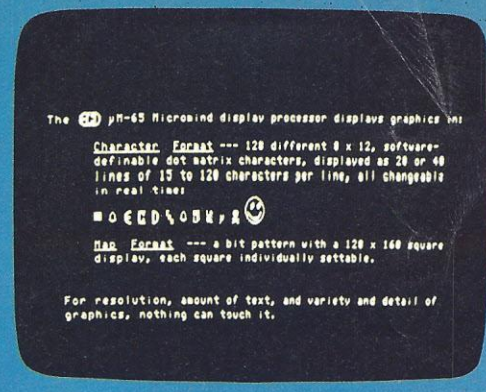
$2.00

SEPTEMBER/OCTOBER, 1977

BIRTH OF THE PET COMPUTER

Is it the first of a new generation?

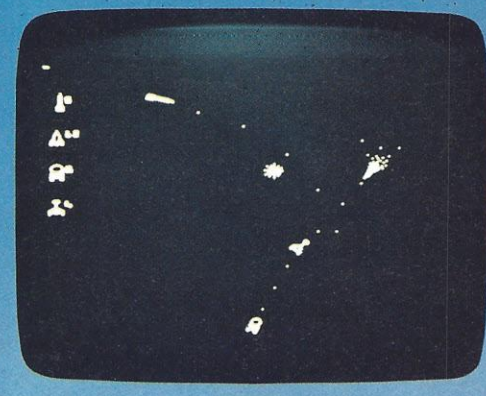


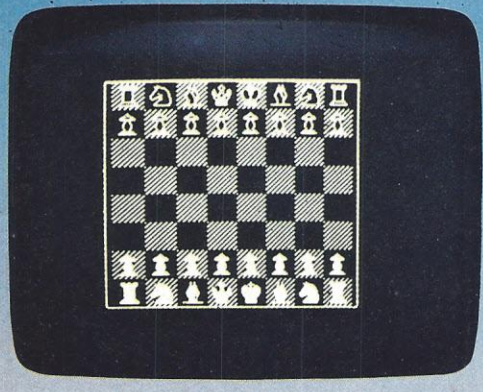


Key Into Maxi-Power @ Micro-Price

Micromind is an incredibly flexible, complete and expandable, hardware/software, general purpose computer system. You won't outgrow it.

Hardware includes an 80 key, software-definable keyboard, I/O interface board, 6500A-series microprocessor (powerful enough for advanced computing), a high-detail graphics and character display processor, power supply, enclosure and connections for up to 4 tape recorders plus TV or monitor. An interconnect bus

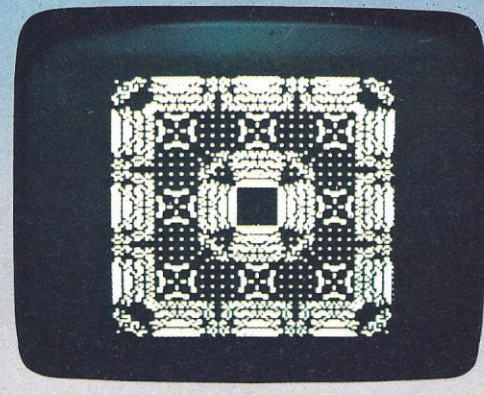




permits 15 additional microprocessors, parallel processing and vastly increased computing power.

System software—including ECD's own notsoBASIC high level language, on advanced error-correcting tape cassettes—provides a word processing editor, a powerful assembler, a debugger, a file system, graphic routines, and peripheral handlers. We also include dynamic graphic games: Animated Spacewar and Life.

ECD's standard Micromind μM-65 supplies 8K bytes of memory. Additional 32K byte expansion boards and a mapping option give Micromind expandable access to 64 Megabytes. Utilizing software-controlled I/O channels, Micromind's advanced encoding techniques load data from ordinary tape recorders at 3200 bits per second.



Micromind comes to you ready-to-use, factory assembled and fully tested. Among microcomputers, it has the largest memory capacity and the fastest storage. You're looking at the work of the finest display processor on the market. You won't find a microcomputer with a more powerful CPU.

You won't find a computer with a more flexible keyboard. You won't find anything to touch it at **$987.54.**

So, quit the kluge scene and key into Micromind. You'll be a main frame performer, with all the comforts of home. We're not fooling...this is the cat's μ!

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(617) 661-4400

ECD

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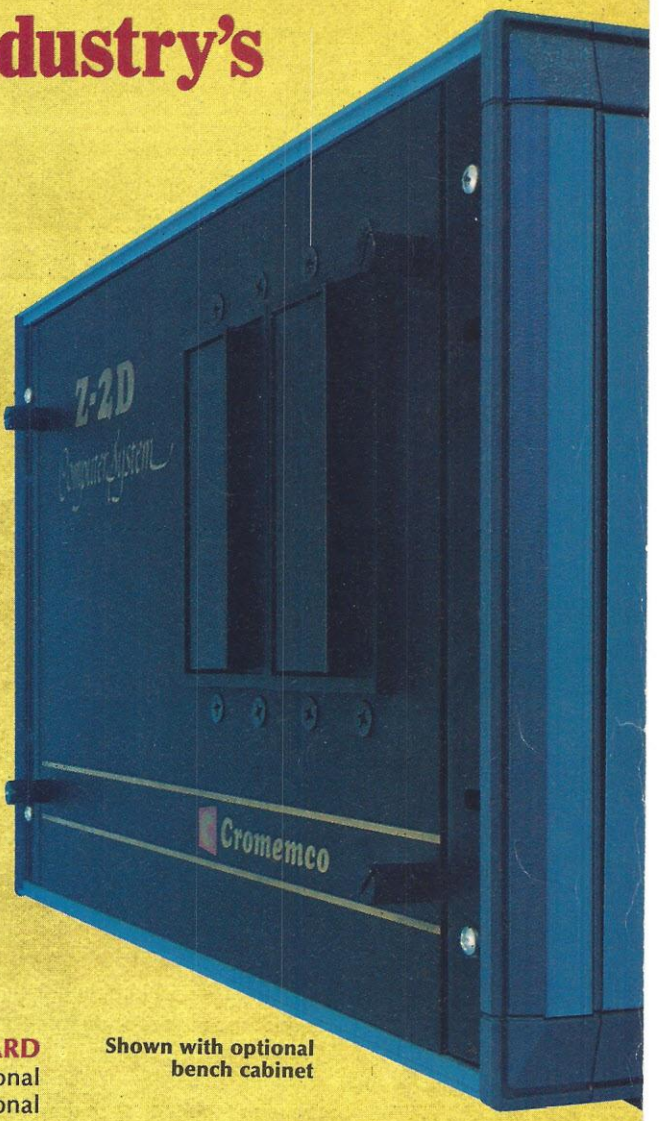
_____ Expiration Date _____

Signature _____

☐ Send me your brochure. P

Actual unretouched photographs.

You can now have the industry's finest microcomputer with that all-important disk drive



The professional-grade microcomputer for professionals

Shown with optional bench cabinet

YOU CAN GET THAT ALL-IMPORTANT SOFTWARE, TOO

Loading your programs and files will take you only a few seconds with the new Cromemco Z-2D computer.

You can load fast because the Z-2D comes equipped with a 5" floppy disk drive and controller. Each diskette will store up to 92 kilobytes.

Diskettes will also store your programs inexpensively—much more so than with ROMs. And ever so much more conveniently than with cassettes or paper tape.

The Z-2D itself is our fast, rugged, professional-grade Z-2 computer equipped with disk drive and controller. You can get the Z-2D with either single or dual drives (dual shown in photo).

CROMEMCO HAS THE SOFTWARE

You can rely on this: Cromemco is committed to supplying quality software support.

For example, here's what's now available for our Z-2D users:

CROMEMCO FORTRAN IV COMPILER: a well-developed and powerful FORTRAN that's ideal for scientific use. Produces optimized, relocatable Z-80 object code.

CROMEMCO 16K DISK BASIC: a powerful pre-compiling interpreter with 14-digit precision and powerful I/O handling capabilities. Particularly suited to business applications.

CROMEMCO Z-80 ASSEMBLER: a macro-assembler that produces relocatable object code. Uses standard Z-80 mnemonics.

ADVANCED CONTROLLER CARD

The new Z-2D is a professional system that gives you professional performance.

In the Z-2D you get our well-known 4-MHz CPU card, the proven Z-2 chassis with 21-slot motherboard and 30-amp power supply that can handle 21 cards and dual floppy drives with ease.

Then there's our new disk controller card with special features:

- Capability to handle up to 4 disk drives
- A disk bootstrap Monitor in a 1K 2708 PROM
- An RS-232 serial interface for interfacing your CRT terminal or teletype
- LSI disk controller circuitry

Z-2 USERS:
Your Z-2 was designed with the future in mind. It can be easily retrofitted with everything needed to convert to a Z-2D. Only $935 kit; or $1135 for assembled retrofit package.

We're able to put all of this including a UART for the CRT interface on just one card because we've taken the forward step of using LSI controller circuitry.

STORE/FACTORY

Contact your computer store or Cromemco factory now about the Z-2D. It's a real workhorse that you can put to professional or OEM use now.

Kit: Z-2D with 1 disk drive
(Model Z2D-K) . . . . . $1495.
Assembled: Z-2D fully assembled and tested (Model Z2D-W) . . . . $2095.
Additional disk drive
(Model Z2D-FDD) . . . . . $495.

SOFTWARE

(On standard IBM-format soft-sectored mini diskettes)

16K BASIC (Model FDB-S) $95
FORTRAN IV (Model FDF-S) $95
Z-80 Assembler (Model FDA-S) $95

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CIRCLE 4

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Chuck Peddle discusses the computer as a household PET.

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Save embarrassment by losing at chess to a computer instead of your friends.

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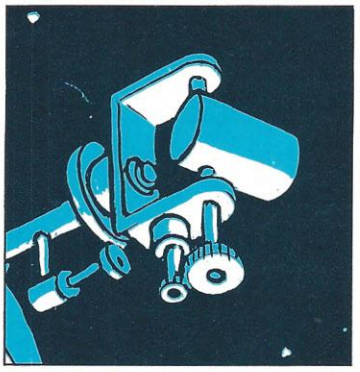

Describe the real world in computerese using mathematical modeling.

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Father writes son: I learned to use the computer!

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SUBSCRIPTION POLICY

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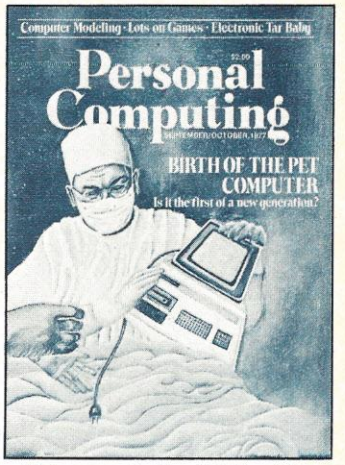
Personal Computing is published bimonthly by Benwill Publishing Corp., 167 Corey Road, Brookline, MA 02146. Editorial office: 401 Louisiana S.E. Albuquerque, NM 87108; telephone (505) 255-8661. Publishing office: 167 Corey Road, Brookline, MA 02146; telephone (617) 232-5470. Controlled circulation postage paid at Long Prairie, MN. Membership application in Audit Bureau of Circulation pending.

Personal Computing

SEPTEMBER/OCTOBER 1977 VOL. 1 NO. 5

COVER



This month, the birth of the PET computer makes the news. Cover illustration by Daniele Josette Coen.

All editorial correspondence should be addressed to PERSONAL COMPUTING, 401 Louisiana S.E., Albuquerque, NM 87108

We welcome submission of manuscripts for publication and pay competitive rates for material accepted. Authors should study the magazine for content and style to avoid sending inappropriate material at expense in time and postage.

Always include a stamped, self-addressed envelope if you want material returned. PERSONAL COMPUTING takes no responsibility for the safekeeping of materials not specifically solicited but attempts to respond promptly to submissions.

STAFF

Letters

"Though I hear, I do not listen,"
"Though I see, I do not look,"
"And my neighbors do the same."
This is privacy at the root level, computers and data bases not withstanding.

John McGinnis
Bradenton, Florida

Yet, one worries that commerce is already hurt by the delusion that its information is correct.

Dear Editor,

How do I go about recruiting to start a computer club?

Leslie Eichenstein
Yonkers, New York

Publicity is where you make it. Write to the magazines, as you have (only write your street address legibly, so it can be published with confidence), visit your local newspaper and intrigue them with the very idea of computer clubs. Also try this with radio and television stations that need interesting material, post notices in schools, contact editors of company publications, run a classified ad in the personals column. Make sure you're easy to contact – phone, address, etc . . . work with a store to put on a well-publicized public demonstration of personal computing . . . and anything else you can think of. We'll be running an article on public relations techniques some time soon.

Dear Sir:

I read with misgivings the suggestion that limited error be allowed in data. (See The Equalizer, May-June, 1977). Though falsifying one question in a hundred results in only 1% error in the data base, the resolution of that data could range from 0-60%. The fact is that telling a lie about your income vs. one about your age for a loan should bring home the point!

The fact is such a suggestion would indeed hurt commerce. Nor would such an idea protect your privacy since data bases are so perverse that the cunning individual could cull out the falsified information from several sources and come up with an accurate profile on an individual.

An elderly Japanese gentleman was asked how he could find privacy in such a crowded town. His reply:

Dear P.C.,

R.O. Whitaker (March/April "Hexadecimal" p. 13) is full of beans. Instead of trying to computerize humans, why don't we spend more effort humanizing computers? I think history has shown that machines are more tractable when changes are needed (over the long haul) than humans: people are still the same shape and size they were 80 years ago, but look at the difference in vehicular transportation. Besides, hexadecimal is a crummy number system – you can't count on your fingers (not a problem for you and me, but it sure is important for the less mathematically inclined).

Tom Pittman
San Jose, California

Dear P.C.,

I just finished reading about "ADAM". I hope that John Peers is not too disappointed when he discovers that he has not eliminated programming at all. Perhaps he has made it a little more forgiving and maybe a little more understandable, but none the less real. And while I think Logical Machine Corp. has good intentions, I do not believe they will succeed in eliminating programmers.

Evidence of this is the fact that they from time to time need to go over the customers data and programs to clean it up so it will use less space on the disc.

Rated G

The Best Game in Town.

Welcome to ComputerLand. An incredible adventure into the world of personal computers. A one-of-a-kind shopping experience.

Each ComputerLand store presents everything you ever wanted to know about computers. And then some.

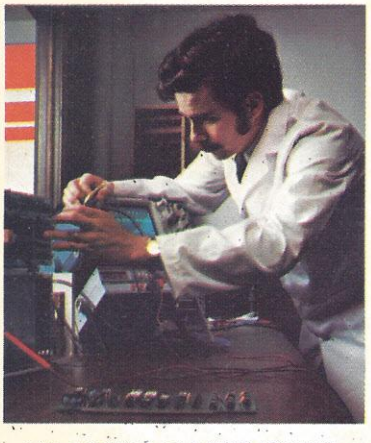
Take our Game Room, for starters. You'll find excitement for the whole family in our endless variety of challenging computer games. You can battle the Klingons in an out-of-this-world game of Star Trek. Create an electronic work of art with a computer controlled TV. Test your skill in a game of computerized hangman.

You can even plot your biorhythm.

But we're more than just fun and games. Each ComputerLand store offers a knowledgeable and personable staff of professionals

to serve you.

Plus the greatest available selection of micro components. Whether it's a data processing system for your business or a computer controlled sprinkler system for your home, you'll find whatever you need at ComputerLand.



Read on.

Genuine Service.

We want to supply you with the one system that's right. Rather than a complete system that isn't. Or a limited system that is.

That's why, at ComputerLand, you deal with real professionals who are also real people. People who speak your language . . . in addition to BASIC, COBOL or FORTRAN.

People, in short, who can offer both the novice and the old hand the same expert guidance in selecting the optimum system he or she needs.

Yet, assisting in the purchase is only the beginning of ComputerLand's service. If the kit you bought requires a little more do-it-yourself than you yourself can do, we provide assembly assistance.

If that complex program proves to be just that, we provide programming assistance.

And if your system breaks down, our in-store service department will get you back up and running.

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ComputerLand offers the finest quality and largest selection of all the major brand names. Like Apple Computer, Cromemco, DEC, Diablo, Hazeltine, ICOM, IMSAI, Lear Siegler, National Semiconductor, North Star, Texas Instruments, Vector Graphics and more.

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Begin with the grand tour of our exhibit areas. "Test-drive" any of our individual systems.

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CIRCLE 5

Letters

But more significant is the fact that they are not the first to design a language which is intended to eliminate programmers. FORTRAN was such a language. Ten years ago I wrote an RPG-like compiler which was intended to be such a language. What happens is that all the things it used to require programmers to do, ordinary people can now do (with only a small amount of training); true. But now, since programming is so much easier, the programmers are able to use the new language to do things which were not possible before. Everyone sees how good these new things are, and the programmers are back in. In the process computers become more useful and we get more control (i.e. better programs). So keep trying, John!

Tom Pittman
San Jose, California

Dear P.C.,

. . . love the menu (spaghetti and lemonade) . . .

Steven Zwillick
Bayside, New York

Dear Editor,

I thought you might like to see that the nightmare has come true. (Re: a Publisher's Memo comment on computer-controlled telephone sales systems, ED.)

This will be one of the best ways to get the government after personal computer users.

Hope something can be done to prevent this. If not, I hope to get my computer before the laws are passed.

Paul Petach
Mountain View, California

The clipping reader Petach enclosed is an advertisement for a computer-controlled telephone sales system. "By making up to 1000 calls per day . . . etc . . . " It's possible that a thousand computer controlled calls a day to the number given in the ad would distract these entrepreneurs from calling other people. No law necessary, just tit-for-tat.

Dear Editor,

Many of the things you say and imply in your magazine are very upsetting to me. I have been a programmer for many years, proud to work in this exciting field. Your lack of respect for the institutions we have established is both rude and shortsighted. You should be grateful that the industry is making personal computers available to private individuals, instead of pretending that just anybody should be allowed to use computers any way he wants to.

You should know that a strong movement is under way to establish legal standards for licensing computer programmers. That way, high professional performance will be assured, and firms that buy computer services will be able to check objective standards of performance instead of guessing about the quality of the people offering work to them. The shabby Lemonade operator will become a memory of the past unless he learns his work properly, shows authorities that he deserves professional standing, and can really contribute to society.

Cancel my subscription.

David Weinglass
Peterborough, New Hampshire

Dear Sir:

Tom Munnecke's article on the Personal Genie was more helpful to me than anything else I have read on programming. I know nothing about this field, and this is the first time I have really been able to figure out what computer languages are all about. Please give us more basic material like this.

Arthur Deaks
New York City

Powerful in computing muscle, yet small in physical size, the Altair™680b offers many special features at an affordable price. Based on the 6800 microprocessor, the 680b comes with 1K of static RAM, Serial I/O port, PROM monitor and provisions for 1K of PROM as standard components. It's good thinking, when you're interested in making a modest investment on a highly reliable computer, to consider the Altair 680b.

Our PROM monitor eliminates the necessity for toggling front panel switches to load bootstraps or manipulate memory contents. Only a terminal and programming language are required for complete system operation. With Altair System software—Altair 680 BASIC, assembler and text editor—you may begin problem solving immediately with ease.

By adding the 680b-MB Expander card, many options are currently available:

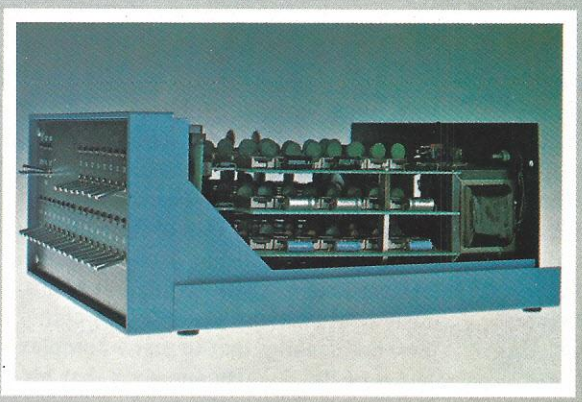
*16K Static Memory Board—Increase your system memory with 16K bytes of fast access (215 ns), low power (5 watts per board) static RAM. 680 BASIC and assembler/text editor are included free with purchase.

*Process Control Interface—A PC card that uses optically isolated inputs and relay outputs that transmit sensory information to and control signals from the computer. A diverse world of control applications is opened up with the Altair 680b-PCI.

*Universal Input/Output Board—If your I/O needs exceed the serial port already on the main board, augment your I/O channels with the 680b-UI/O. By implementing the optional serial port and two parallel ports, you can simultaneously interface to four terminals.

*New Addition—Kansas City Audio Cassette Interface—Use the 680b-KCACR to interface your Altair 680b with an audio cassette recorder for inexpensive mass storage of programming languages, programs and data.

Available in either full front panel or turnkey models, the Altair 680b presents many computing capabilities at a low cost—without skimping on performance. See it today at your local Altair Computer Center or contact the factory for further details.



mits

Good Thinking.

2450 Alamo S.E. Albuquerque, New Mexico 87106
dealer inquiries invited.

With Colonel Colt's six-gun, the uneasy average man was equal to the dangers of the frontier. The uneasy average man at today's frontiers of knowledge can hold his own with the personal computer. It is: THE EQUALIZER

by Nels Winkless III

Dudley Lynch is a writer, not a computer technologist deeply involved in the personal computing revolution. Yet, as an outsider, he has stated the essence of the movement better, probably, than any insider to date. In an article titled "Home Computers" in the TWA AMBASSADOR in-flight magazine for July 1977 he commented, "With just a little training, the owner of a computer can write his or her own programs, and – no mistaking it – that spells P-O-W-E-R."

Personal power must surely be the primary motivation behind the surge in personal computing – the same kind of personal power offered by the private automobile around the turn of the century and by CB radios in the last decade. (Indeed, the horsecollar, which didn't come into use generally in Europe until about the eleventh century A.D., may be classed as the same sort of technological advancement. Until a horse could pull a heavy plow without choking, human beings were the primary field draft animals.) The automobile made it possible to go where you want to go, when you want to go, without relying on a hateful central bureaucracy for schedules and "allocation of personnel and resources." Anybody, with very little skill, can operate a car, and be free of the system. CB radio similarly frees the unskilled operator from the telephone system, letting him contact whom he will from wherever he is. Few in our populace have the dedication and patience to become competent ham radio operators, but any slothful boob can confound the system with a cheap CB radio. Users are not attracted by technology, but by personal freedom. The individual is not overwhelmed entirely by his environment, but has, with these technical devices, the power to influence his own situation to a large degree.

Personal computing offers the same kind of freedom and power. We haven't seen much exercise of these virtues, but then, we ain't seen nothin' yet. Consider, for example, the political implications of personal computers. The average private citizen, who ordinarily feels left out of the political process, observes his one vote is worth having but seems inadequate for expression of his opinions and feelings on the many complex issues of the day. He perceives that his interests are lost in the swirl of great forces about him. If he is driven by frustration to begin a political movement of his own, he usually falls exhausted before he can gain much influence. He settles for tepid support of some large organization that seems on the average to suit his tastes, though many of its personnel are offensive screwballs. He gags down the bad with the good. Why? Because the task of finding, reaching, and influencing other individuals of his own stripe is simply too large and expensive.

Just watch; the personal computer will be used increasingly to gain political power for private individuals. A far larger assortment of screwballs will be speaking with loud voices, adding to the wholesome turmoil that keeps us free. The reasons are not obscure or complicated. The basic fact is that you can do a lot more work with a computer than without one, just as you can plow more acres in a day by chasing a horse with a plow than by dragging the plow yourself. No profound intellectual mystery is in this.

Imagine that you want to organize a large group of people who agree with your notion that all streets in the country should by law have six-foot high curbs so that drunk drivers can find the sides of the roads, and navigate more safely. You have only a limited number of practical courses of action, depending not only on your supply of personal time and energy.

You must contact your potential supporters, express your interest in them, persuade them to respond favorably to you, extract cash contributions from them and persuade them to recruit more energetic members to the cause. All of the new recruits must be clearly identified and qualified in the central files of your organization so that only you have access to the lists. If you don't keep central control, the organization will fragment quickly into quarreling factions concerned with peripheral matters like mechanisms for quick entry to buses via trapdoors in the roof, etc. . . The thrust of your effort will be blunted.

How many people can you handle in your organization while you earn a living at your regular work? Consider one exemplary organization now operating. The group had about three hundred members a couple of months ago. The members are attracted to the group by crank letters written by the organization's founder to the local papers, by classified ads, by occasional news reports on the activities of the group, and by loud harangues that the founder delivers from a stepladder on street corners.

The group gains about one member per day, on the average. Each member sends in his membership dues on joining, asks for a receipt, and gives an address to which literature can be sent.

The founder photocopies incoming checks and applications for his records,

continued on page 11

Can every intelligent, energetic crank in the country hope to stir up a following and harass the wits out of his fellow citizens, using the freedom and power allowed him by a personal computer?

IS YOUR DOLLAR BUYING AS MUCH POWER & FLEXIBILITY AS TDL'S XITAN SYSTEMS PROVIDE?

OUR CUSTOMERS SAY THINGS LIKE THIS ABOUT TDL PRODUCTS:

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"Great product." ..... KMM, Bella Vista, Ark.

"... high quality components, good engineering & complete documentation... up and running without any problems." ..... WP, Seattle, Wash.

"Excellent." ..... Col. DWW, Santa Maria, Calif.

"Very impressed with superb quality." ..... SK-L, Boston, Mass.

XITAN alpha 1

When we combined our highly praised ZPU board and our System Monitor Board, we defined the standard for the industry; we integrated more power and flexibility in two slots of our motherboard than most other systems can muster using five or more boards. When we put this setup into our rugged aluminum case we created the first XITAN system, the *alpha 1*. By adding a CRT terminal and/or teleprinter you will have a complete computer system.

KIT: $769 ASSEMBLED & TESTED: $1039

XITAN alpha 2

By adding a Z16 memory module and our PACKAGE A software to the *alpha 1* we created a second XITAN system, the *alpha 2*. Thus, a complete and extremely powerful micro-computer system emerges well worthy of you who are operating at the most sophisticated levels. The XITAN *alpha 2* provides you with 18K of RAM, 2K of ROM, 2 serial I/O ports, 1 parallel I/O port, our 1200 baud audio cassette interface as well as our extraordinarily powerful software package which includes 8K Basic, the Text Output Processor, the Zapple Text Editor and the Relocating Macro-Assembler. Add your own I/O device and GO...with the most powerful and flexible micro-computer package ever offered.

KIT: $1369 ASSEMBLED & TESTED: $1749

IF YOU ARE A BEGINNER, YOU WON'T EASILY OUTGROW THE XITAN SYSTEM.
IF YOU ARE AN ADVANCED USER, YOU WILL DISCOVER XITAN IS EXACTLY WHAT YOU NEED.

†Write for descriptive brochure on the XITAN ***alpha*** series and system software. When you ask at your dealer, say "ZY-TAN."

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We've uncovered some innovative applications, too: The sailboat architect who puts equations and algorithms on an iCOM disk to test his nautical theories; the student who has automated a bowling alley; the iCOM dealer who designed an environmental control system for a university.

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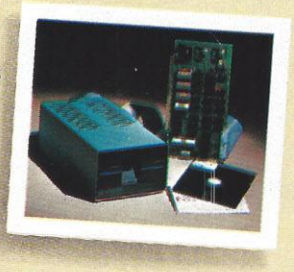
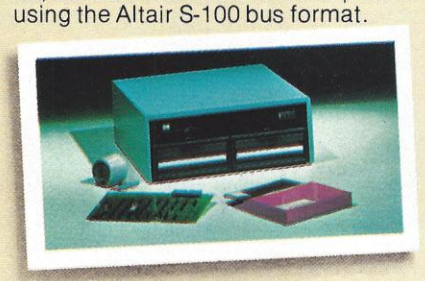


More Models

iCOM has Frugal Floppies™, Dual Floppies, Microfloppies™ (using the new 5¼" diskette), and other new approaches to floppy disk systems. Each is hardware and software compatible with Altair™, IMSAI, Poly 88, Sol-20 and other microcomputers using the Altair S-100 bus format.



More Software

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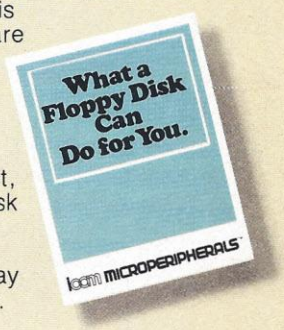

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THE EQUALIZER

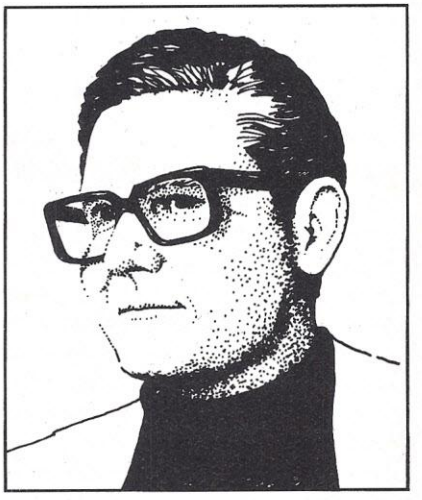
assigns a membership number to the new recruit (entering name and number in a numerical list), and enters name, address, phone number, date of membership, and membership number on an accounting ledger page which is filed alphabetically. He then writes all of this same information out on a 3 x 5 card with comments on the character and interest of the new member, so that he has a handy reference file that can be carried with him. He types the newcomer's name on a membership card and on a certificate, addresses an envelope, then types the new name on a master sheet of sticky-back address labels so that future mailings can be handled by photocopying the masters onto more sheets of labels.

The new member costs the founder fifteen minutes and a lot of patience in proofreading seven different typed entries of the name. That's fifteen minutes a day at the present rate . . . plus the time involved in handling orders for literature (making all the proper bookkeeping entries), attending to half a dozen address changes a month, writing speeches, writing new classified ads, calling the newspaper to argue about the copy and the bills, writing and mailing news releases, talking to members, lobbying with legislators, reading new literature, and haggling with the bank and the IRS about bad checks, etc. . .

At this modest level of 300 members, the organization was consuming thirty man-hours a week. The great fear of the founder is that he'll succeed in gaining a larger membership that consumes far more volunteer staff time, almost all his. If you are planning to gain enough political muscle for your high curbs, you're going to need far more than 300 members in your movement. The founder of the exemplary group is already so tired that he often falls from the ladder into the gutter.

Is much of this work duck soup for a small computer system? Can one or a few dedicated people readily contact, organize, fleece, inspire, agitate, account for, reassure, and discipline a significant number of members in an action group by applying the power of a small computer to the task? Can every intelligent energetic crank in the country hope to stir up a following and harrass the wits out of his fellow citizens, using the freedom and power allowed him by a personal computer? Will the bureaucrat who tries to inhibit this freedom and power be asking for a suit of tar and feathers? We shall see.

P-O-W-E-R? You said it, Dudley. Thanks.



With a degree in studies of Russia and East Europe, editor Nels Winkless has worked twenty some years as a professional outsider, writing about other people's work, chiefly in technology. He has written books, magazine articles and many non-theatrical motion pictures (working in Chicago, San Francisco and Hollywood). To his surprise a lot of technology has rubbed off on him, and led to management of research projects in fields ranging from image dissection optics to use of tumescent bacteria in instrumentation. He remains V.P. of a small research foundation.

ADA BYRON
the romantic computer programmer

by Terence McLaughlin

Programmable computing was "personal" at its very beginning, before professional/commercial/industrial activity was even possible. A beautiful and talented young countess with a love of mathematics produced a work, well over 100 years ago that has proved to be a masterpiece of computer theory.

1833, and the cream of London society is gathered together, the men severely elegant in skin-tight trousers and cutaway coats, the women like overblown roses in their voluminous skirts and wide 'bishop's sleeves'. A *soiree* at the court of King William IV? A concert by that stylish young musician Mr. Johann Strauss? No – fashionable London was attending the Mechanics Institute, for a lecture by Professor Lardner on a new calculating machine.

Scientific lectures were all the rage at that time, but it is doubtful whether this one was appreciated by many of the audience. Dionysus Lardner was demonstrating Charles Babbage's 'difference engine', a startlingly original mechanism for calculating mathematical tables. Most of the audience, as one observer put it, "stared at the machine as a savage regards a watch or a pistol".

However, one young woman in the crowd, admired as much for her romantic associations as for her dark good looks, was entranced by the lecture. "Miss Byron, young as she was, understood the machine's working and saw the great beauty of the invention," as the same writer said.

world of mathematics

Augusta Ada Byron was 17, the only legitimate child of the poet Lord Byron, and the unfortunate centre of a marital squabble that had been conducted with all the publicity of a modern film-star's divorce. Byron, from his second home in Switzerland, brought lawsuits to prevent his wife Annabella taking the child out of England. Annabella's mother retaliated by inserting a direction in her will that Ada should not be allowed to see even a portrait of Byron until she was 21 . . . and so on through years of spiteful recrimination on both sides, in which Ada's interests were not so much safeguarded as used as a legal weapon. No wonder that the girl grew up with a deep distrust of emotional involvements and a corresponding love for the impersonal, predictable worlds of mathematics and machinery. When she was eight, she played not with dolls but with model ships that she had built for herself. Taken on a trip to the new industrial areas in Coventry, she seemed oblivious of the people she met, but spent hours studying the machines. When she was 16, Augustus de Morgan, the distinguished mathematician, declared that had she been a man she would inevitably have become Senior Wrangler – the highest mathematical honour at Cambridge University.

Augusta Ada Byron (1816 – 1852)

But she was not a man, and had to follow the only possible 'career' for a 19th century young lady. She was presented at Court when 18; there is a hint of her distaste for this in contemporary description of her as "a young lioness drest in white satin and tulle, etc." Shortly afterwards she married William King, later Earl of Lovelace, and had three children.

Even so, despite the social demands on the time of the young Countess of Lovelace, she kept up her mathematical interests. She had met Charles Babbage at the lecture on his calculating machine in 1833, and they became close friends, writing to each other regularly on topics that ranged from the design on machine tools to the latest society gossip. There is little doubt from these letters that Babbage was rather in love with the beautiful young countess whose mind so closely matched his own; for her part, Ada was quite definitely in love with Babbage's analytical engine.

too refined

Babbage had conceived the principle of this machine in 1833, just when the work on the difference engine was nearing completion. The earlier calculating machine was merely an extremely elaborate adding machine – able to calculate mathematical tables rapidly and to an accuracy of 20 significant figures, but limited in the types of work it could perform. The analytical engine was what we should now call a programmable computer, with an almost infinite capacity for changes in its program. Electronic or even electrical caculators were a long way off: Babbage's machines were mechanical contrivances

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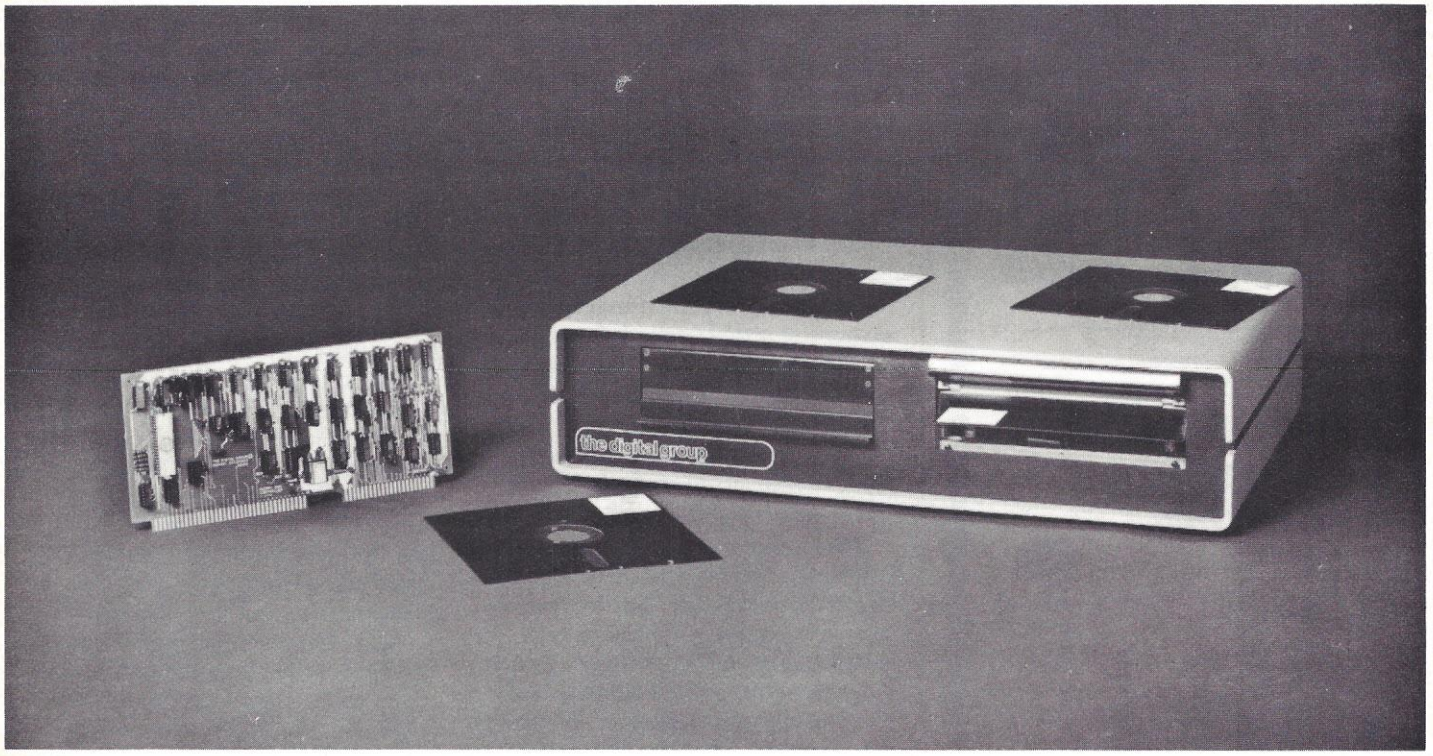

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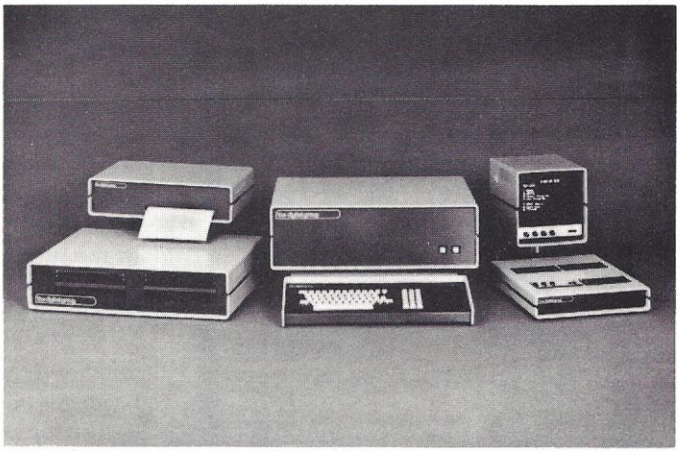

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CIRCLE 9

depending on the interaction of hundreds of accurately machined gearwheels. This was the main problem. In spite of the skill of engineers such as Joseph Clement, who made most of the parts for Babbage, the whole idea was really too refined for the technology of the time.

However, this did not prevent Babbage and Ada from setting up the theory of how the machine would work when it was finally completed, and many of the most revolutionary and modern-sounding proposals came from her, computer music, for example.

"Supposing that the fundamental relations of pitched sounds in science of harmony and musical composition were susceptible of such expressions and adaptations into algebraic formulae, the engine might compose elaborate and scientific pieces of music, of any degree of complexity . . ."

There are many such ideas in the letters, but they might have remained scattered, or even lost, but for an almost accidental occurrence. A celebrated Italian engineer officer, General Luigi Menabrea, visited Babbage and was shown the prototype of the analytical engine. On returning home, he wrote a technical account of the machine in French, *Notices sur la Machine Analytique,* and naturally sent a copy to Babbage for comment. Babbage suggested that Ada would be the ideal person to prepare an English translation, and she set about this task. It was soon obvious that Menabrea, though giving a lucid and accurate account of the machine as it stood, had not properly realized its enormous potential for the future. Ada started to add footnotes, and then, as these grew longer and the text, appendices enlarging on the theory, practice, and possibilities until her 'translation' ran to four times the length of the original paper, with lengthy footnotes on every page and no fewer than seven appendices. This work, her memorial, is a masterpiece of logical computer theory which could still be used to chart the uneasy interface between programmer and machine. Ada had no doubts about the importance of the analytical engine.

"A new, a vast and a powerful language is developed for the future use of analysis, in which to wield its truth so that these may become of more speedy and accurate practical application . . ." But she was also aware (perhaps more than some modern writers) of the limitations of the computer.

"The *Analytical Engine* has no pretensions whatever to *originate* anything. It can do whatever we *know how to order it* to perform!"

Some of her detailed recommendations deserve comment. The programs for the analytical engine were to be supplied by punched cards – an idea taken from the perforated plates that controlled the weaving of threads in the Jacquard loom but which were a completely novel means of storing information on any other subject. Ada realized that Babbage's simple idea of what we would now call sub-programs, that could be repeated at any stage in the calculation, and invented a technique, 'backing the cards', for bringing these sub-programs forward at any particular stage. It is a reflection on the deficiencies of our information system that a large American corporation, relatively recently, spent a large research budget on sub-programming only to come up with the same answer that Ada Byron had produced in the 1840s. And she was working on the theory of a machine that was never finished.

Apart from her mathematic and logical advances, her later life was pure reaction to the emotional trauma of her childhood. Forbidden to see even portraits of her father until she was 21, she developed an ultra-romantic view of that surpassing poet, but wayward man. It is recorded that she appeared at a Court ball "clad in a semi-oriental dress, meant to impersonate one of Byron's heroines. Her hair in dark plaits, and woven and tied with pearls, hung to her waist."

One is reminded of Hairdee in *Don Juan.* "Her clustering hair, whose longer locks were rolled in braids behind, and though her stature were Even of the highest for a female mould, They nearly reached her heel . . . "

She also had the idea that she and Babbage, surely the most distinguished mathematicians of their generation, could create a system to beat the bookmakers, the money to go to the development of Babbage's analytical engine (by this time the British government had withdrawn the funds originally subscribed for the difference engine). It is unlikely that the 'bookies' of the period were better calculators than the syndicate, but the fact remains that their low cunning proved superior.

Ada died of cancer in 1852, at the age of 36, exactly the same age at which her father died. She was buried beside him. Whatever his faults, which were many, they had genius in common. Had she lived longer, it is almost inconceivable what such a brain could have done for British mathematics. ■

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CIRCLE 11

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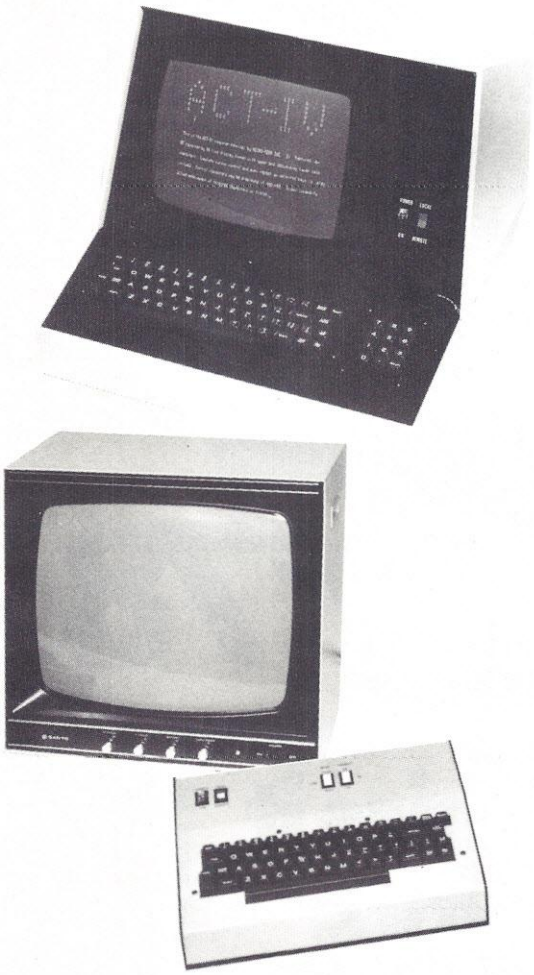

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Standard features include:

DISPLAY: Upper and descending lower case characters
24 lines of 80 characters
Auto-scrolling

KEYBOARD: Full ASCII with cursor controls and auto-repeating cursor movements, 'space,' and 'period.'

TRANSMISSION MODES: Character by character or "page" mode in which trailing spaces and blank lines are not transmitted.

SPECIAL FUNCTIONS: relative and absolute cursor addressing,home up, erase to end of line, erase to end of screen, fixed tabs, and display control characters

TRUE EDITING: in PAGE mode, the user can insert or delete characters on any line and insert or delete lines on the page. Preexisting data on the screen is appropriately rearranged by the ACT-IV processor to accommodate the user's command.

DATA RATE: 300 to 19200 baud

The ACT-IV is available in two configurations. The ACT-IVa comes in a compact (briefcase compatible) cabinet without video monitor for $550.

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CIRCLE 12

Random Access

Just Pucker Up

The World's First International Whistle-Off has been scheduled for October 1st, 2nd and 3rd in Carson City, Nevada, a miniscule metropolis that may come to regret the whole thing. Whistlers are to compete in a dozen different categories ranging from solo whistling to music, through all-girl whistling (in teams) and foreign language whistling (Swiss Alp, Jugoslavian sheepherder whistling, etc. . .), to whistling with novel accompaniment (bones, cowbells, bicycle pumps, and all that). The winners receive some of this and some of that, mostly notoriety, which they will richly deserve.

This disgraceful event (much balleyhoo in the New Yorker, for example) is of interest chiefly because the ADAM computer (manufactured by the contest's sponsor, Logical Machine Company — see PERSONAL COMPUTING's May/June issue) will be a contestant. Right, a contestant, whistling a single tune, MY WAY.

Surely the personal computing field is populated with computers that can whistle as well as ADAM, maybe even better, and with a bigger repertoire! Who will meet this challenge with his whistling personal computer? This magazine has already lodged a protest with Logical Machine Company over the omission of a special category for whistling personal computers and has been assured by John Peers, the Monty Python of the Computer Industry, that an ad hoc competition among left-out contestants (personal computers, astronauts and magazine editors, among others) has already been discussed. Aggrieved parties who appear in Carson City ready to blow will find company on the steps of the courthouse. They'll find no organized competition, no official recognition, no prizes, but no antagonism either. If you want to take your chances, haul your whistling computer to Carson City for the occasion.

As a matter of fact, word is that very large numbers of whistlers and whistler watchers are already planning to descend on Carson City for the event. You'd be wise to find out about accommodations and the like.

MY WAY, indeed! Personal computers, pucker up.

Radio Shack Jumps In

Just before PERSONAL COMPUTING's press time, Radio Shack formally announced its first entry into the personal computing market, and here's a quick report on their surprising system. The TRS-80 microcomputer system is in the PET class, with BASIC in ROM, with 4K of RAM (expandable, of course) and an interesting selection of application programs on cassette. The computer is Z-80 based, packaged in a very small case with a full 53-key alphanumeric keyboard. With power supply, the computer/keyboard is offered at $399.95. A full system with a video monitor and cassette recorder included is priced at $599.95. Peripherals like printer and disk memory are due in December.

Packaging

Computers aren't all coming in Startrek School of Design packages these days. The handsome cabinets displayed here house some very interesting personal computer systems. You'd never guess. That rolltop desk is surprisingly small, by the way, but manufacturers who have spent a lot of money and effort developing a product seldom provide pictures of the products with people, so that the product can be judged in context by an outsider. No matter, Compu/Time will be glad to tell you all about computer products and furniture if you'll drop them a line at 8532 Hamilton Avenue, Huntington Beach, California 92646.

Is There a Cat In The Bag?

Control Data Corporation wants to ship a CYBER 76 computer to an eager customer, the Soviet Union. The US Government is dragging its feet on issuance of an export permit for the system, because there's some worry about giving away the US lead in computer technology for the price of a few machines. Some private firms, like Texas Instruments, are strongly criticising the CDC sale. CDC argues that the machine is ten years old, that steps have been taken to prevent information leakage, and that this country would benefit from the machine's use in the Soviet Weather Bureau.

Now there's an issue for computer-fanciers to ponder and comment upon. National security and high technology are both involved, rightly or wrongly. When experts disagree, is it any wonder that mere legislators are confused? Has Ohio Scientific shipped any Challengers to the USSR? Has the Apple been polished up for Sverdlovsk?

The matter of information exchange is not simple. Some years ago at a big international meeting, the US scientists were willing to speak freely about our computer technology, but were forbidden to discuss atomic fusion. The Russians could talk freely about fusion, but were forbidden to comment on computers. Since those were the two subjects of primary interest, it made for some odd conversation.

There are real differences in approach. We take it for granted that computers should be furnished with full alphanumeric keyboards; only a few of us are able to work comfortably with numerical symbols alone.

The Russians didn't get around to alpha with their numerics until very late in the game, years after they began a serious push into computers, well into the sixties apparently. All numbers, no words! No wonder they couldn't talk about it. Is there a MIG-6464 personal computer somewhere in the works? With 48-bit words, 78rpm record memory, a wire-recording option, Nixie-tube display, switches with pull-strings? Maybe. And do they do some things smarter than we do?

They do some things much fancier. When Dr. Wolfgang K.H. Panofsky returned to his linear accelerator at Stanford a few years ago with some snapshots of his tour to Russian accelerators, his friends were treated to some remarkable pictures. The huge control console for one system was housed in cabinets that looked like old black-crackle paint stuff left over from a 1935 movie. The dials and meters were all big (easy to read), slice-of-pie shaped artifacts. The white-coated operators were wearing communications headsets that were built into what looked like old-fashioned leather flying helmets. Amazing stuff.

Best of all, a wide angle shot revealed that the control room was not a cramped, crowded hole like the things we ordinarily build, but a spacious hall with a very high ceiling. Hanging from the ceiling over the ancient cabinets, meters, and helmets, was an enormous crystal chandelier. The Stanford accelerator is nice, all right, but it doesn't have a crystal chandelier.

The CYBER 76 undoubtedly handles alphanumerics with consummate grace, but black crackle paint is probably not standard on production models.

High Hopes

The new Heath Company H11 microcomputer is built around the Digital Equipment Company LSI-11 microprocessor, which uses an instruction set almost identical with that of the highly successful DEC PDP-11 minicomputers. The happy thought is that LSI-11 systems will be able to use the huge PDP-11 software library with no difficulty. Heath's H11 is one of several 16-bit systems now entering the market . . . and optimism over the success of the product is high. A release from DEC is headlined: "Heath Inks Multi-Million Dollar Digital Contract." The three year contract covers more than LSI-11 hardware, but DEC will provide only a part of what Heath sells. Multi-Million? Will 16-bit systems seize the market? The next couple of years will be full of action as the question is discussed.

Star Wars

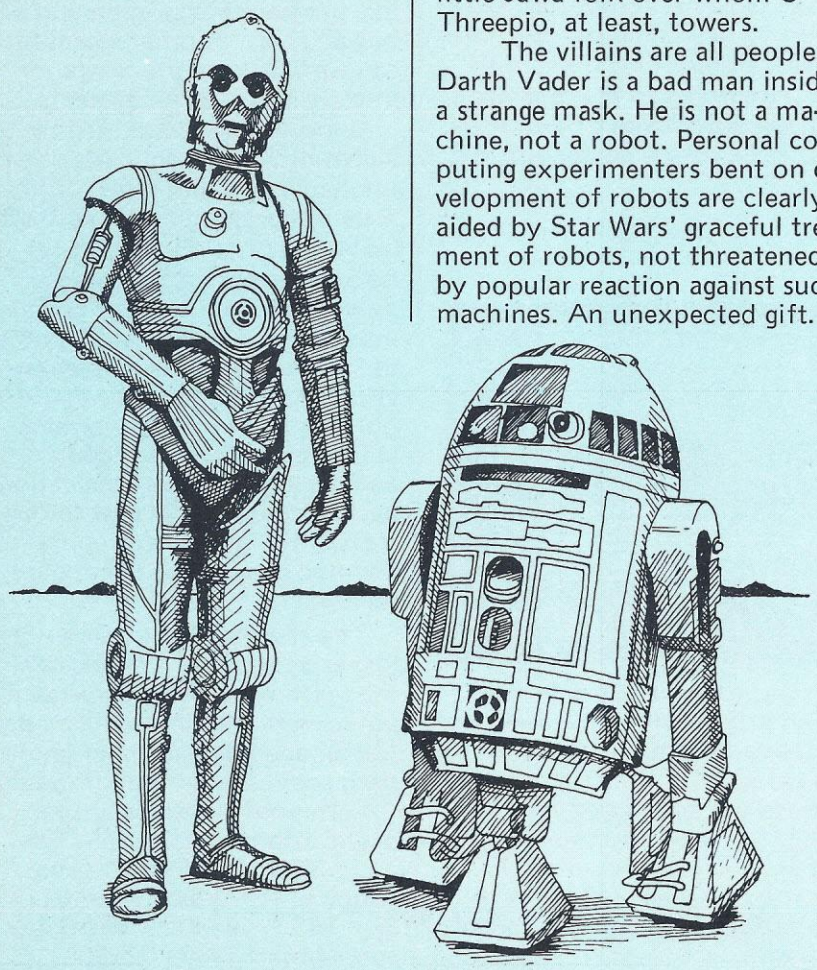
Star Wars, the science-fiction movie that's breaking boxoffice records, is a barrel of fun, well worth seeing despite many trifling flaws. One matter deserves mention here, because it's handled so well — the robots.

Robots have always been a mess in the movies and on television: awkward, arbitrary, threatening, and of doubtful utility. (With the notable exception of James Foxworth's Questor in a made-for-television movie that appeared a couple of years ago.) People in show-biz don't always understand robots. Why should they? Technologists don't always understand show business. Some years ago a technical friend was asked to review a script for a proposed science fiction movie featuring a robot. He went back to the producer with favorable review and a proposal to build the robot described for $200,000. The producer chewed his cigar for a few seconds, then said kindly: "But I don't need a two hundred thousand dollar robot. All I need is a guy in a robot suit and a good publicity man."

Star Wars features splendid robots, warm, useful, interesting. They are a bit clumsy, but a guy in a robot suit can do only so much. In the Ballantine paperback book based on the movie, C-Threepio (the gold robot) is described as having "liquid movements." Well, it's hard for the man in the stiff suit to have liquid movements, and the figure in the movie totters a bit, though winningly.

The key feature of those robots is that they don't hit anybody. Even when Artoo-Detoo is bolted directly into the warplane, his function is to help the pilot, not to bash other planes, other robots, or people. In fact, the robots are at the mercy of the little Jawa-folk over whom C-Threepio, at least, towers.

The villains are all people. Darth Vader is a bad man inside a strange mask. He is not a machine, not a robot. Personal computing experimenters bent on development of robots are clearly aided by Star Wars' graceful treatment of robots, not threatened by popular reaction against such machines. An unexpected gift.



More On Chess

Wherever you turn, somebody seems to be spending money and energy on computer chess; it's more than the average interested chess-player can comfortably follow. Relief is at hand. Doug Penrod is now producing the COMPUTER CHESS NEWSLETTER (1445 La Cima Road, Santa Barbara, California 93101). If the first issue is any clue to the future, this is just what computer chess needs . . . reports on new systems, new games, new people in the field, lists of available literature, comments from insiders, good, basic tutorial stuff.

The first issue even included a reproduction of a fascinating hand-written letter from Bobby Fischer, who did play chess again against one of the new machines in the field (the chess challenger, see p. 44), and complains of shortcomings in the machine's performance. It's almost impossible for him to lose to the machine, he says, even spotting the dumb machine a queen and a rook for openers. But. . . but. . . Bobby Fischer?

Penrod hasn't figured out a yearly subscription price yet, but he'll send the next couple of letters to interested parties for 75¢ a copy, in advance.

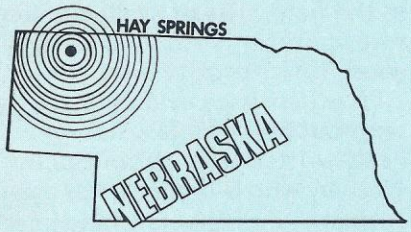
The New York Show

If you can't make it to our Midwest Personal Computing Show, October 27, 28 and 29 in Chicago, but are in the New York area instead, you may want to catch the Personal Computing Expo at the New York Coliseum. Although PERSONAL COMPUTING Magazine has no connection with that Expo (or with a number of other shows in which our name is embedded), we're pleased to note the activity. BYTE Magazine is producing the program of seminars and lectures for that show, promising a real treat for the computer hobbyist. Come to the Chicago show if you can, but . . .

Network

Imagine that you are a personal computer owner in the small farming community of Hay Springs, Nebraska. Your friends are fascinated that you have a computer, but they aren't interested enough in the technology to be helpful.

You subscribe to several computer magazines, write occasional letters to the manufacturer of your system, and have twice visited the nearest computer store



in Denver, Colorado. You pick up what you can and after a while you're computing well enough to set up a small Lemonade Computing Service using a farm accounting program you wrote yourself.

The personal computer gives you some stature in the community and you make practical use of it. But you dream of better things. Is there a way to use your computer to make Hay Springs, Nebraska and yourself a major information center?

Seem farfetched? PERSONAL COMPUTING has learned of two personal computing network proposals that would make your goal at least feasible. These networks would let you tie your computer to thousands of other computers throughout the country and eventually the world.

One of these proposals comes from a newly formed nonprofit organization called PCNET (Personal Computer Network), located in Palo Alto, California. This committee is hard at work defininin a standard set of conventions to govern "all levels of intercomputer communication."

The goal of PCNET is the creation of regional (followed by national) personal computing networks for the computer-to-computer transfer of messages and files. According to the organization, the advantages of a computer based message center are: it's faster than mail, doesn't require anyone on the other end of the line (phone), is less time consuming and easier to use than telegrams, and less expensive than telephone or telegram.

PCNET is starting a series of experiments and seeks people with personal computers to take part (particularly if you're living in the Palo Alto area). Contact them by calling Dave Caulkins at (415) 328-2411 or writing him at 437 Mundel Way, Los Altos, California 94022.

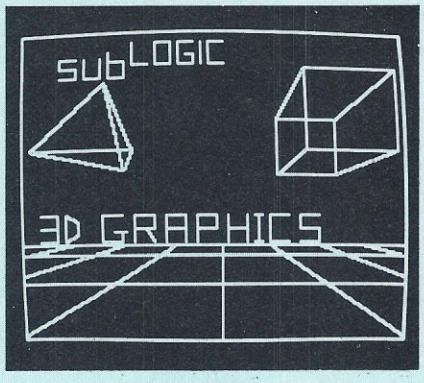
Another, more ambitious network project is already in the initial stage of operation. Called TECHNET, this system allows you to hook up your personal computer to a DECsystem-10 time-sharing computer. Once you have done this, you can augment your own computer with mass storage, line printing and plotting as well as a full range of time-sharing services including BASIC, FORTRAN, ALGOL, COBOL, text editing, program preparation and debugging aids. In other words, you can turn little micro-computer into a very powerful system.

Conceived and operated by Network Technology, TECHNET is scheduled to become a "full-scale resource exchange network" by Spring of 1978. You'll be able to exchange messages as well as computational and input/output facilities with other users of the network. Other envisioned services include computer time on a variety of large computers, access to standard and custom business application packages, electronic newsletters, mailing list and bookkeeping maintenance and programming services.

The charge for this service is as low as $1.80/hour — well within the reach of most personal computer users. You'll need a modem (telephone interface) and you'll need some specialized knowledge to turn your computer into a major information center. For more information on TECHNET contact: NETWORK TECHNOLOGY, Box 145 Prudential Center, Boston, Massachusetts 02199.

3-D Graphics

Computer graphics tend to be crude in resolution, largely because so much information is required to create a picture that a big computer system is needed to handle the job. As small systems speed up, it becomes possible to do useful, though still crude, graphics work. Matrox in Montreal, for example, has been supplying interesting graphics packages to the personal computing field. Now Sublogic Company (P.O. Box 3442, Culver City, California 90230) is offering new microcomputer graphic software that's still lacking in good resolution, but draws crude pictures in "3-D," that is, with a sense of perspective on a standard 2-D CRT screen. The company has high hopes for making use of this in driving and flying



simulations, artistic projections, design projections, engineering analysis and games.

Two versions of the graphics package will be offered, one in BASIC for "any microcomputer system," and another in 6800 assembly language. BASIC version at $22, 6800 version "slightly more."

Easy Access

Personal interaction with a computer may become far easier for the public if Vertel, Inc. of Wellesley, MA realizes commercial success with its new "Microloader" system.

The company noticed that people have grown accustomed to carrying credit cards, using them for all sorts of miscellaneous purposes like picking teeth and scraping ice from windshields. Since this suggests that the average user is at ease with such cards, Vertel developed an ordinary plastic credit card that holds four broad stripes of magnetic oxide on which a total of 1024 bytes of digital data can comfortably be recorded. Further, they developed a reader/writer that can put information onto the card or take it off.

Why? The company thinks the system may be handy in desktop calculators, payroll systems, machine tool controls, word processing, point-of sale terminals, waveform function generators, test equipment, process control, electronic games and home computers. One can imagine dropping a dime in a slot and getting the day's horseracing data dumped on a card from a home or office for processing and determination of the day's betting. Gambling not for you? Commodities trading, maybe? Stocks?

Picking Up The Pieces

One of the earlier companies in the personal computer field, SPHERE of Salt Lake City, has gone into bankruptcy, leaving the usual trail of regret and recrimination that is part of such proceedings. A good many owners of the 6800-based SPHERE computers find themselves left without support and without much hope. Very frustrating for them.

Helpfully, a software house, Programma Consultants, 3400 Wilshire Boulevard, Los Angeles, California 90010, has set about providing support for SPHERE owners. The move is not wholly altruistic; Programma was a supplier of SPHERE software, and the crash leaves them holding the bag. The surprising feature of their effort is its thoroughness. The company mailed out a 40+ page packet of information that does a better job of describing the SPHERE system, answering general questions, identifying suppliers of compatible equipment and listing available software than most literature produced by manufacturers in this field for their own products.

A large question-and-answer section is especially useful . . . "How good is software put out by TSC for this system?" (Very good, says Programma, and they tell why) . . . "Are there other floppy disc units (besides PerSci) that can be used with the SPHERE system?" (Yes, try the Ohio Scientific Inc. 470, says Programma, and they discuss that product in some detail.) Good stuff. Readers may be interested in this package of information. Programma will send the material, first-class, for $3.00.

Standards

The computer field in general, and personal computing in particular, has been plagued by incompatibility of one system with another, not only hardware, but software. What is the standard S-100 bus . . . or is there such a thing? It's almost impossible to find out what works with what, not only for consumers, but for manufacturers trying to provide useful new products.

After some talks at the West Coast Computer Faire, ALF Products, Inc., a tiny manufacturing company that presently offers no commercial threat to anybody else, took the bull by the horns and set up the CENTRAL STANDARDS LIBRARY (CSL) with the hope of distributing reliable standards information to the industry at large on a non-profit basis. (So far, it's costing ALF a lot of time and out of pocket operating cash.) CSL will not set standards, merely report them in some standard style as they become available.

For a copy of the first standard, write CENTRAL STANDARDS LIBRARY c/o ALF Products, 128 S. Taft, Denver, Colorado 80228.

Cash Grants For Progress In Robotics

Three individual grants of $100 are being offered by the United States Robotics Society to students who survey practical activity in research and development on robots in specified areas of the world. The surveys must be performed for academic credit with formal approval of professors.

The Society is seeking an estimate of robotics activity worldwide, and these first grants are the beginning of a general search for the robots. More than seventy members of USRS alone have reported personal activity on robots.

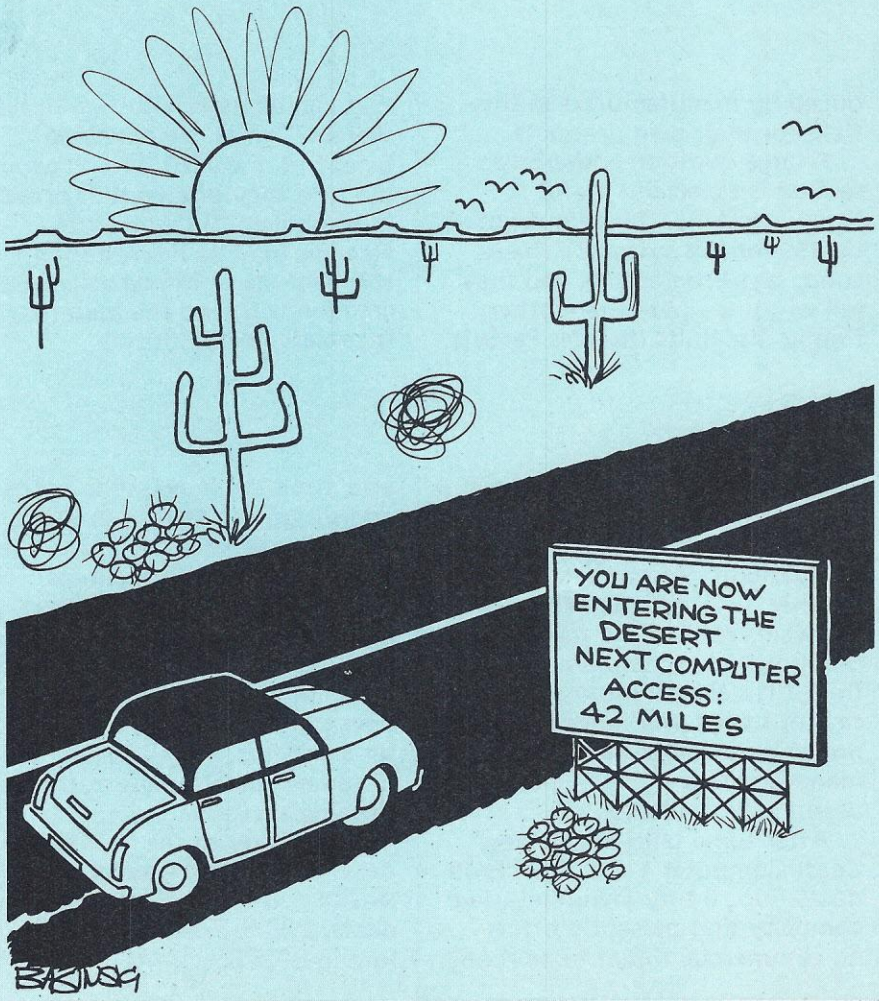
Preliminary proposals from applicants are due on or before 30 September 1977; completed reports are due on or before 30 June 1978. For details, write: Survey Grants, United States Robotics Society, Box 26484, Albuquerque, New Mexico 87125.

Only The Names Have Been Changed . . .

Computer Shack, Inc., one of the major franchising operations in computer retailing, has changed its name to COMPUTERLAND

Says Ed Faber of now-Computerland, the new name "avoids the long-range dilution of image that could result from associating high-technology quality products and modern store designs with the public's perception of the name "Computer Shack."

The new name does have a nice ring. At last report, neither Tandy Corporation, operators of the zillion "Radio Shack" stores, nor Pete Conner, operator of the lone, independent Computer Shack in Albuquerque, was rushing to change corporate names.



Games From The Real Game People

Big names in the old game business are announcing startling new products employing microprocessors — Parker Brothers, Milton-Bradley, Mattel — and that's real new, because it brings power to the personal computing movement. So far, the games are relatively unsophisticated when compared to elaborate Startrek exercises that require the full attention of a two-thousand-dollar computer system. However, these dedicated systems aren't stuck with video or teletypewriter display; they are far more interesting in many ways than "traditional" computer presentations, and innovation is running rampant.

Consider these comments about Parker Brothers' first computer game from Robert Doyle, Vice-President of MicroCosmos, a company in Cambridge, MA that is consulting exclusively to Parker Brothers on microcomputer based games, "Although the game was originally designed on an 8080-based Intellec MDS system, the production model is a member of TI's TMS 1000 family, a single-chip microcomputer with 1K bytes of ROM, 64 nibbles of RAM, 19 input/output lines, a built-in PLA to create character codes for a small multi-digit display and an onboard clock.

"It has some snazzy design features like a "sleep" or powerdown mode. If nobody pushes a button for 30 seconds, it shuts off everything except RAM and two blinking decimal points to indicate that it's still on. In this mode it draws only twelve milliamps of current so the nine-volt battery can last for days. Although it's a PMOS device, it is protected from damage by static discharge or accidental reversal of the battery leads."

This isn't the kind of talk that used to be heard in the corridors of the Parchesi and Chinese Checker factories. Keep your eye open for exciting action. ■

The first complete low-cost microcomputer system for home, business or education!

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The TRS-80 is for people who want to use a computer now — without the delay, work and problems of building one. The system is fully wired, tested and U.L. listed — ready for you to plug in and use! Program it to handle your personal finances, small business accounting, teaching functions, kitchen computations, innumerable games — and use Radio Shack's expanding line of prepared programs on cassettes. The Z80-based system comes with 4K read/write memory and Radio Shack Level-I BASIC stored in read-only memory. Memory expandable to 62K bytes. Includes CPU, memory, keyboard, display, power supply, cassette data recorder, 300-page manual, 2-game cassette program. Designed and built in USA by Radio Shack. Only 599.95.

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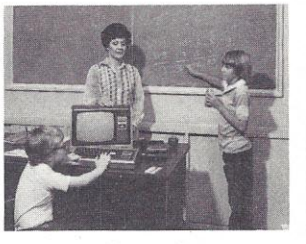

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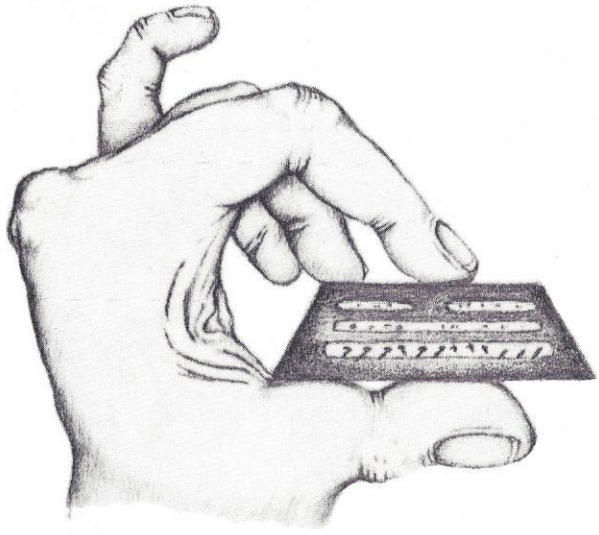


HOW BIG?

The typical personal computer that's big enough to operate with BASIC on any scale can handle real tasks for a non-technically-minded user , has 8K to 16K of random access memory, has cycle time around two microseconds, costs about a thousand dollars, uses 8-bit (one byte) words and weighs something between seven and twenty pounds, depending. (The little Altair 680 weighs seven pounds, the Digital Group computer in its thick aluminum case, about fifteen pounds.)

You may be entertained to consider what's at the other end of the scale from these small systems of whose power we are so proud. PERSONAL COMPUTING chatted with some folks who deal with big computers and got these interesting, if unofficial, statistics.

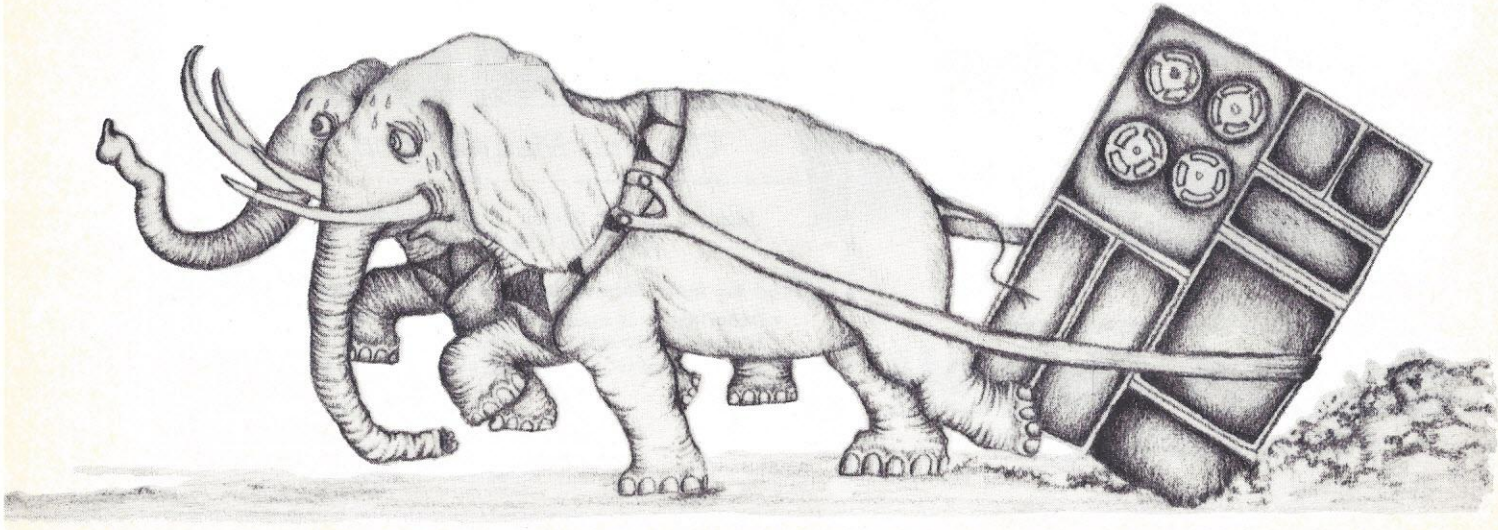
IBM's biggest standard system to be the 370-168-3, which, with four megabytes of memory weighs something over sixteen thousand pounds, more than eight tons. It uses a 32-bit word, has a CPU cycle time of 80 nanoseconds, comes with a minimum of one megabyte of random access memory, and sells for a little over three million dollars in the minimum configuration. (If you don't have the purchase price in your pocket, you can lease the machine for sixty-five to seventy thousand dollars a month.)

Amdahl is vigorously competing in the giant computer mainframe market with its model 470V/6. They point happily to the machine's light weight at a mere four-and-a-quarter tons and its air-cooling. (Some other big systems are water-cooled.) The machine operates at a cycle time of 32.5 nanoseconds, using a 32-bit word with a minimum of one megabyte of random access memory. Memory can already be increased to eight megabytes and there is talk of increasing that to sixteen megabytes.

A remarkable fact about the Amdahl system is its use of Large Scale Integrated circuits, making this what the manufacturer likes to call a "fourth generation system." (First generation computers used tubes; second generation used discrete transistors on PC boards; third generation uses small-scale integrated circuitry and the fourth generations, LSI. The boundaries between generations are a bit fuzzy, but the computer industry refers comfortably to the various systems in this terminology.) The whole 470V/6 contains only 51 printed circuit boards. Presumably, these are not boards of the size that plug into your SOL, but their number seems modest in a big machine.

Fifteen years ago, the trade name UNIVAC was virtually a synonym for "giant computer." The UNIVAC 1180 now uses a 36-bit word, has a cycle time of 125 nanoseconds, and comes with a minimum half megabyte of core. (Some of us old folks automatically refer to random access memory as core, a hangover from ancient times.) You can lease an 1180 for as little as $50,000 a month.

Control Data Corporation offers (in limited quantity) their STAR-100 computer with 64-bit words, 40 nanosecond cycle time, and minimum memory of half a mega*word*. Nobody mentioned the weight of this system, but



there was impressive talk about its ability to hustle data around in a "bandwidth of 112.8 billion bits per second."

These are the systems at the other end of the spectrum from our homey little systems. Notice that light travels about a foot a nanosecond. If you're working in increments of 32.5 nanoseconds and you pump data into a wire more than 32 feet long, the data may still be bumbling along through the pipe when the next action starts. As the computers grow bigger and faster, the speed of light actually becomes a physical constraint on their design. For the time being, you've little to worry about in your KIM.

Perhaps these examples will be useful to you in figuring out what computer is which generation and where it fits in the general scheme of computerdom. Tom Munnecke has suggested some additional rules-of-thumb for distinguishing Minis from Maxis and Micros.

If the owner's spouse casts icey stares at it, it's a micro.

If there is a line of programmers waiting to use the keypunch or terminals, it's a maxi.

If the CPU has wires strung all over, and a soldering iron next to it, it's a micro.

If you can watch the football game on the terminal between compilations, it's a micro.

If three salesmen in white shirts and wingtips answer your inquiry, it's a maxi. If one salesman in a flowered shirt and tennis shoes answers your inquiry, it's a mini. If no one answers, it's the Post Office losing the literature sent you on the micro.

If the ad says the computer has "advanced function," it's a maxi. If the ad says the computer has "extensive software," it's a mini. If the ad says the computer will have an extended BASIC soon, it's a micro.

If the operating system takes up 1 megabyte of memory, it's a maxi. If it takes 40 kilobytes, it's a mini, and less than 8 kilobytes, it's a micro.

If you can pick up with two fingers, it's a micro. With two hands, it's a mini. If you need two elephants, it's a maxi.

Other such rules-of-thumb may occur to PERSONAL COMPUTING readers. We'd be glad to hear them. ■

Attend the Chicago Personal Computing Show™ October 27-29 at the World's Largest Holiday Inn near O'HARE Airport.

See the New Affordable Computers

Now's your chance to see the new low-cost computers you've been reading and hearing about. On display at the Chicago Personal Computing Show will be new computers for your home, professional, business or education use.

For example, Radio Shack will unveil its new $598 complete computer with typewriter keyboard, memory, cassette recorder, video screen and programming. Is it everything that people in the electronics industry are saying it is? You can see for yourself in Chicago. Or how about the Commodore PET? At $595 this computer was the first to be aimed at the mass consumer market. How about the Apple Computer? Digital Group? What new business applications have been developed for the Altair computer and how does it compare with the minicomputers from Wang or Data General?

Literally hundreds of personal computers and related equipment will be up and running for your own, personal hands on inspection. You'll see the latest in inexpensive line printers, floppy disks, video terminals, memory boards and cassette interfaces. You'll also see the latest programmable home video games, many of which are evolving into true home computers.

You can learn from the experts what the computer revolution is all about. See all the new applications for these wonderful machines, compare price and decide what kind of computer would be best for your own use. Attend one of the many free or paid seminars. There's even a computer school where you can learn how to program while actually using a personal computer.

A personal computer can be your equalizer in a complicated world. Come to Chicago and learn what this new product, which could outsell handheld calculators, is all about.

Over 10,000 people and hundreds of exhibits are expected for this big, three day event. Admission: $10 at the door or $15 for all three days. See page 39 and 103 for more seminar information.

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What Basic 4, DEC, Microdata, Data General, etc. should know about distributors.

Randal wrote the book.

CIRCLE 16

Photo by Tom Munnecke

Chuck Peddle is Microprocessor Manager for Commodore Business Machines, Inc. of Palo Alto, California and is the key technical man behind the PET computer.

Personal Computing: Tell us how the PET got started.

Chuck Peddle: Primarily, it's an attempt on Commodore's part to capitalize on vertical integration. When they acquired MOS Technology [Ed. Note: MOS Technology is the company that developed and has been manufacturing the 6502 microprocessor employed in a number of personal computers such as the KIM, Ohio Scientific, and Apple], giving them the semiconductor base they needed to be a major factor in the calculator and games market, the next question was: "What do we do for a major microcomputer base technology?" Personal computing was just starting to be a real market back in October and November of 1976.

Personal Computing: Wasn't the market a couple of years old by then?

Peddle: When I say "real market," I mean the *volume* was starting to pick up. We could reasonably ask if the concept of computing was directly extensible into the normal mass markets. Was it something desirable or meaningful to the normal human being, rather than a hobbyist? The conclusion was that computing has several facets for the normal person. It allows him to take advantage of computing power for many of the things he does now.

Personal Computing: Such as?

Peddle: He doesn't *need* a major 360 system to balance his checkbook, do file systems, plan menus, or things like that . . . but if we can price the computer low enough . . . As a matter of fact, one of the applications for the home computer will be effectively dealing with other people's computer systems. It brings the computer into the hands of the guy who's having to deal with computers every day, even though he doesn't necessarily realize he's dealing with computers . . . gives him his own power. In addition, of course,

Interviews of Chuck Peddle and Dick Heiser by Tom Munnecke

A Personal Computing Interview

CHUCK PEDDLE ON THE PET COMPUTER

The PET is big news, representing what appears to be a clean break from commercial and hobbyist computer systems requiring technical skill and dedication from their operators into a consumer market where no qualifications are required of the customer, save the ability to pay a consumer price (roughly $600) for a complete computer system. This is an experiment on a grand scale, and it remains to be seen whether the market predicted really exists, or is imaginary, whether the product is reliable at its price or not, whether the company can deliver or not, and whether the people backing the work can stick it out or not in spite of inevitable difficult problems.

Personal Computing is devoting a great deal of space to the PET because of its news value. Meanwhile, back at the ranch, other manufacturers are producing superb new systems that will be treated appropriately as the opportunity arises. Apple, for example, is offering its own 6502-based system with remarkable color graphics capability and a number of surprising novel features; TLF has announced its microcomputer version of the PDP-8, giving users the opportunity to tap an enormous reservoir of existing software. Ebnek is out with a 16-bit system, as is Heath. The Digital Group, Compal, Polymorphic Systems, Imsai, Mits, Southwest Tech, Ohio Scientific, Processor Tech, Cromemco, ECD, TDL, National Semiconductor, Micro-Term, Vector Graphic, and the other pioneers aren't just sitting around. Super stuff is all around, but PET is the cliffhanger. Can Commodore do it?

there's the whole concept of sophisticated games.

Personal Computing: What about using it for banking?

Peddle: This guy will have a computer with which he can plan his monthly budget. He and the bank can work out an agreement that will probably flow like this: He has his computer do his planning; he approves the plan in his home, and transfers a cassette to the bank, letting the bank automatically do the paying.

Personal Computing: What are the other new areas?

Peddle: A lot of people have uses for a computer, in their business, in their work – and I separate the two. Say I'm a high level manager for a corporation; it turns out that I don't really have the access to a computer that everybody thinks I have. The computer doesn't really do *my* job; it does the *corporation's* job. Now I can have something that I can use at work and use at home. We're going to see a lot of people actually able to work at home. We know programmers are going to be able to do that, and we're pretty sure design engineers will be able to. We think a whole class of management types will be able to . . . and a lot of clerical jobs that are currently being done in a collective environment. Summing it up, there are a lot of applications which say this is a new mass market, so we chose to *make* it a mass market with a mass market price.

Personal Computing: Why don't you build your market on the solid base of hobbyists who really understand it?

Peddle: Only by selling to the consumer could we really get the mass market. The whole premise behind this was to pick a price at which the consumer wouldn't feel uncomfortable. When you consider that you're buying a computer that ten years ago sold for over a mil-

lion dollars, that's pretty interesting. In addition, we felt that a normal human being could use this computer. That's the reason it has BASIC as a language. That's the reason the heavy emphasis on graphics is built into the machine. Graphical things are fun, interesting, and make the results of a calculation more meaningful. Computers should not only be easy to use; they should have *meaning* for you. The PET plays games like backgammon and blackjack, because they already have meaning in the home.

The PET can also be used to teach. You saw the triangular representation where you actually draw triangles . . . and pictures . . . that's part of the educational process. We see people coming into the consumer marketplace by means of the teachers who are already teaching BASIC. Many of the schools will now be able to teach children at ages 7, 8 and 9 the fundamentals of programming and the fundamentals of using a computer.

Personal Computing: This computer

COMMENTS

JAMES J. BLACKMAN

Jim Blackman has been PERSONAL COMPUTING's outside marketing consultant (See **America's Most Advanced Cottage Industry**, *March/April 1977 issue), very knowledgeable in the mechanics of consumer marketing. When asked to comment on the PET, Blackman demurred on the grounds that he didn't know enough about their program. However, he provided this commentary, outlining the thoughts he'd have if a client had assigned him the task of selling a hundred thousand computers to consumers in the next year.*

To be sure, there is a big consumer market, at least on the horizon, for personal computers. Unfortunately, it may be a little late arriving, especially if the providers of technology and products are too hasty in their rush to merchandise their machines to the masses. I am concerned that some technologically hot manufacturers may put all their betting money on a win ticket in the first race and wind up departing the track much too early.

Even computer professionals are sometimes fearful of black boxes, which, in the beginning, can present greater possibilities for problems than solutions. Everyone, whether the old fashioned or the easy enthusiast for the newfangled, automatically shies from the unknown. This is especially true when buying decisions are being made. It's the unknown about personal black boxes that I feel makes them frought with problems for premature entrance into the wonderful world of mass consumers. Understandably, the logic runs, "we must be first to introduce a great technological breakthrough to this world of waiting consumers." Unfortunately though, today at least, consumers are not really aware that they are waiting for the world's first black box at a new low price. Although pricing elasticity is unquestionably one of the greatest weapons a consumer marketer can wield there are a great many contingencies.

Black boxes at a bargain may not sell quite like hand-held calculators and digital LED watches. First there must be a clear consumer understanding of value. It's really the oldest of logics, requiring that the seller first prove: what's in it for me? Computers by any name are not inherently simple.

Only with adequate communication comes understanding, and after that, appreciation for a proposition. Manufacturers who are now closing the package around their ready-to-go black box should ship it out with great care. Air express delivery can be wasted if the product arrives ahead of a merchant's readiness to receive it.

And communication to consumers of the here-today benefits of personal computers must precede the most important sale in the marketing chain, the one to the ultimate consumer. In the mass consumer market there is little sales value to potential alone. Only with the absolute hobbyist is there the patience to toil for value received from the purchase. That's the big question in consumer minds today. "What will I receive if I put my hard earned dollars into a beautiful little black box?" (Instead of a microwave oven, color console, or whatever.) That question must be answered first.

I think there will prove to be not one, but two distinct and different markets for consumer computers. Each will require a different set of marketing disciplines and decisions. Both markets are already forming on the vanguard of products now on consumer view.

I would call *home* computers the robot-like devices which perform preprogrammed household tasks. The magical microwave ovens and the keen-sensed home security devices are in the early wave of products which will slavishly perform the unexciting repetitive everyday tasks that you and I would rather leave to a little robot, rather than become involved ourselves.

On the other hand, *personal* computers may be the most descriptive handle for the genre of micromarvelous instruments of direct personal involvement, or interaction, if you will. They're already here and have their tentacles on that most prized of consumer possessions, the color TV set. TV games (now in the third generation) are already a consumer market success.

In my opinion there is no black box alive or aborning that can serve both markets. Just too confusing, unwelcome, expensive, unwanted, etc., etc . . . too much!

I come down with a feeling that manufacturers/marketers must define their capabilities and then choose their market: either the robots for rational household chores, or the interactive devices of consumer communication.

The latter market is the real turn-on for me because it's the emotionally charged products that consumers always seem to find a way to buy. Merchants call them "impulse items," products that appeal mostly to our wants, rather than our real needs. However, to be wanted first by merchants and then by consumers, personal computers must be packaged attractively for retailed counter display and they must be promoted at

will teach kids about computers?
Peddle: Not only will it teach computer programming; it will actually teach lessons, allowing children in the schools to proceed at their own rate. Kids will relate to it. They have already shown that they relate to standard Teletypes; now they're gonna have a chance to relate to something graphical.

Personal Computing: You have pretty much a captive audience in the schools.
Peddle: Another strong pull into the home will be that people are going to discover computing is fun. That's what the show is really all about. All these people milling through here [Ed. Note: the Computer Faire in San Francisco] represent a class of people, most of them fairly young, who have had access to a computer at some time in their lives. They discovered that using a computer helps to solve problems in their day-to-day work and in addition to that, it's a lot of fun. These people represent the experience that we're now trying to bring to everybody. It's a new art form, a new form of expression . . .

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the point of sale via store display and splashy newspaper advertising. This requires a great deal of manufacturer insight and preparedness. There's got to be zing in the product itself, sing in the advertising and promotion, and profitable ring in the cash register. It's only the comprehensively profitable product that gets real merchant's push today.

For the foregoing reasons I would be slow to avail my consumer-worthy computer to regular mass retailers. Better to confine marketing for the present to the specialists who have the time, qualifications, and reasons to clearly communicate personal computer benefits to consumers. Some day Sears and K-Mart may offer them, but for the while I think we need retail computer store personnel to really sell them.

I strongly support the strategy of a controlled marketing rollout, responsive to whatever rate of development the consumer market justifies, but with managed restraint, staying short of the possibility of being overspent and underdeveloped too early.

A final word about the product itself. In my judgement, personal computers will be most readily received if they are sold as receiving sets.

One of the intrinsically incorrect marketing notions today is that consumers will want to program their personal computers with applications of their own conception. Wrong, Wrong, Wrong!! You can't leave them with that kind of scary personal challenge. Consumers are a lot like businessmen. They buy solutions, not problems.

The biggest consumer dollars are spent today on reception-type instruments, i.e., radios, TV sets, phonographs, etc., which avail the consumer to outside sources of information and entertainment.

In my opinion, no amount of whistles and bells on the hardware will alone be able to attract and sell consumers. Nor will future potential be motivating enough for consumers, other than hobbyists, when it's time to plank down at the point of sale.

On the other hand, the concept of hooking up a personal resources receiving set to outside sending sources just might sell very well, and the selling emphasis will be on the new software available to consumer subscribers. Subscribers? In my judgement that's the way to go, via connection to cable TV systems, telephone connection to computerized online data bases and mailable floppies and cartridges.

I think that personal counseling by computer is a very exciting concept. Few consumers have available to them the services of a personal counselor in matters of career planning, marriage, parenthood, money management, psychiatry, health maintenance, legal considerations and so on. The concern for privacy and the limitations of traditional one-on-one counseling may be perfectly resolved through implementation by personal computer receiving sets which permit individual interaction of consumer with computer. The potential personal comfort of an easily accessible in-house counselor might be an extremely strong buying motive for consumers.

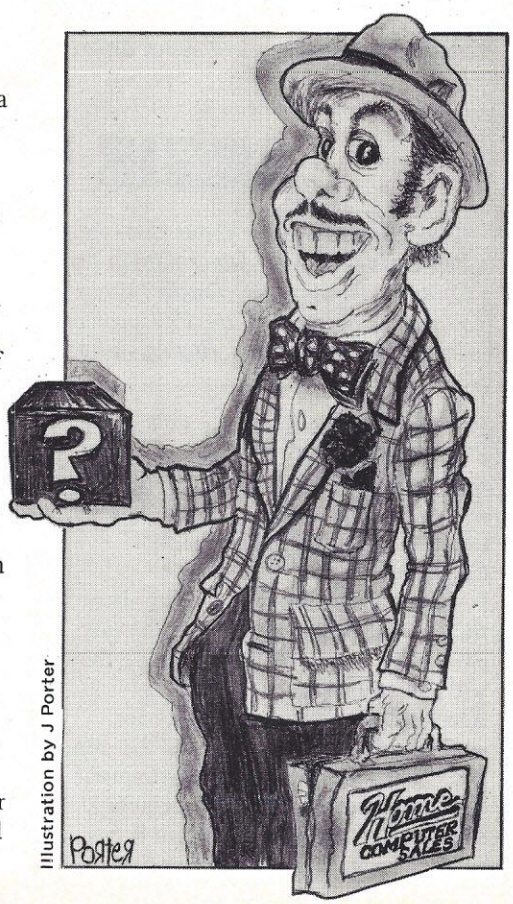

Illustration by J Porter

The saleability of informational, educational and entertainment resources is already proven in the exploits of the book and record clubs. Britannica and World Book do very well with the big ticket sale of pure reference materials. Consumers also like to collect all kinds of things, including expensive books. This was eminently evidenced in the now famous Franklin Mint sale of leather bound book classics to American Express Credit card holders. A collection of 100 books at the rate of one a month, $28 a throw.

The acquisition of desirable possessions is a lifelong pursuit of most consumers. The marketplace is inexhaustible and the possibility of striking overnight new product success is ever present. However, anywhere outside of an Arabian sheikhdom you can run dry pretty quickly if given to wildcatting efforts in unproven areas. There is just no substitute for carefully researched exploration of consumer interest. Out of it often comes the one or two little twists in management decision which can change the whole course of events and constitute the sometimes tiny difference between a hit or a miss in the consumer products marketplace.

and I'm not pushing it as an "arty" thing. The average human being can now take all the mystery out of computing. The computer isn't something to be afraid of, but a tool, something to create with. I think creativity is something this country is looking for.

Personal Computing: The ordinary person will use the computer that well?

Peddle: I feel that in the long run there will be more housewife programmers than professional programmers. They will have the time and opportunity to use that kind of product. Housewives have been a badly neglected section of our society. We don't offer them enough creative outlook. Suppose you take the previous generation housewife: she's afraid in many cases to get back out and go to school. With this kind of program, she can effectively give herself an education in an environment where she's not afraid. If she doesn't do too well, she still has a chance to do an activity that expands her mind and her social consciousness. That's becoming very important.

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DICK HEISER

Dick Heiser is the now-old-time proprietor of the first successful retail computer store. With two whole years of operation to give him perspective, Heiser views the PET with a surprising degree of excitement.

Personal Computing: You think the PET will help the personal computing market grow?

Heiser: I'm predicting according to what I call Heiser's Law, which is that the market is growing ten times bigger every year . . . and that means a thousand percent. Now, Venture Development predicted in its study of the market that the growth would be 37.2%, but I'm predicting a thousand percent because we're really getting into consumer products, where the only skill the customer needs is the ability to write the check.

The more you see the PET, the more you like it. First of all, it comes assembled, and really works; second, it's cheap; third and most important of all, it's a real, honest-to-goodness computer. It's got the best BASIC that's available on the market today, upper and lower case, high-quality video with graphics, and all sorts of neat features.

Personal Computing: You think it will have a big effect?

Heiser: This is what I call the second generation revolution in personal computers. It could put a million machines like this out there in the next year and a hundred million in the next several years. It's possible that fifty million people will own two computers each.

Personal Computing: Will the price drop dramatically?

Heiser: The way it did on calculators? No. The reason is that you add features until the customer spends about what he can afford, about a thousand dollars, for a very valuable personal tool. The customer will get more for his money, but he'll spend as much.

Personal Computing: What will people do with the computer?

Heiser: Organize things. For about four months, I've been using a personal computer to organize my own agenda. One of the main things they need for the PET is sort of an item organizer. You want to organize a stamp collection, etcetera? That is what a lot of people are going to start to do.

Personal Computing: How about direct electronic banking and credit from the person's home?

Heiser: No, you don't have enough control. If you had a BankAmericard system in personal hands, you'd have a problem. We're not talking about money transfers, we're talking about transferring information . . . and information transfer is growing according to Heiser's Law, too. That's what the numbers say.

Personal Computing: Won't the big companies like IBM and AT&T jump in when they see this is important?

Heiser: They can't change direction that fast, and they're running so hard the other way. They can't keep up with a company like Commodore that knows how to mass produce an item.

Personal Computing: You think the PET is really significant?

Heiser: It's a fantastic product.

ARNIE KARUSH

Arnie Karush was for about three months System Sales Manager for both the PET and the smaller, older KIM at Commodore. At the end of June, he left Commodore abruptly. Tracked down at home by an editor who half-expected a bitter indictment of the PET project from an aggrieved former insider, Karush delivered a remarkable, ringing endorsement of the PET.

Personal Computing: Is the PET real?

Karush: Absolutely. I think a hundred thousand units will be manufactured and sold in the first year, swamping the field with real computers for the first time.

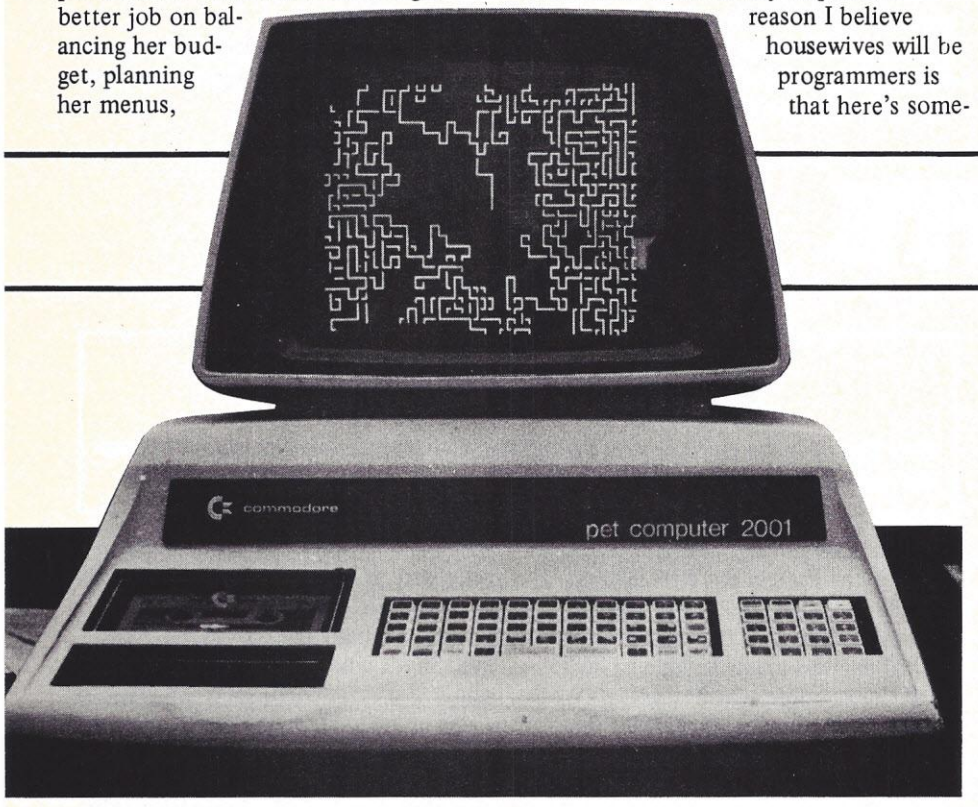
Personal Computing: Who will notice the impact of this, apart from the tiny percentage of our total population that will actually have the computers?

Karush: This will create a force for small computers that will rock the minicomputer industry. The minicomputer industry has been very comfortable, selling a lot of product without doing anything very new for the past few years. On the average, each PET will create at least one new programmer who can generate software to make computers do something. Imagine a hundred thousand new programmers, all wanting to use computers, all able to afford real, working computers. Think of the effect on software.

Personal Computing: By and large, the computer makers have hated the necessity of providing the software

Karush: Commodore understands the importance of software; they treat the requirement as an opportunity. They are planning to solicit good software from authors, check the work out to

She has a chance to do something other than being a homemaker, even if she doesn't want to go out and get a job. She can rationalize using the computer on the basis that she's doing a better job on balancing her budget, planning her menus, or actually doing her shopping by computer. (Cable TV tied in with this thing will revolutionize shopping one day. It doesn't matter when.) That's the utilitarian reason. The really important reason I believe housewives will be programmers is that here's something that allows them on a one-to-one basis to learn any activity they want to learn.



Personal Computing: She'll become a programmer to make the machine do exactly what she wants?

Peddle: Here's a situation where she can take tests without exposing herself to ridicule or failure. She'll be able make sure of its value, and publish it for general use, paying royalties to authors.

Personal Computing: Why is Commodore doing this instead of somebody else doing it?

Karush: They realized its potential market impact first.

Personal Computing: Did they go out looking for the product or did Chuck Peddle come in and sell it to them?

Karush: That was before my time, but I think it was a two-way proposition. Commodore had a business relationship with MOS Technology, and it was natural for them to discuss this sort of thing with Peddle when he was there. Commodore has one real achievement to offer – mass production capability. They realized that they could ignore computer history and treat this like a calculator or a watch. The technology isn't anything really new. That is, it's nice technology and the product is well engineered, but no scientific breakthrough is involved that other companies don't share. A product like PET could have been brought out by Datapoint or Wang a year ago.

Personal Computing: Do you see any problems for the PET, things that outsiders may not notice, because they aren't involved in daily operations?

Karush: No, there are always problems, but I don't see anything special or big. Selling is certainly not a problem. I imagine that the first six months worth of sales is already accounted for.

Personal Computing: Old-timers in the computer business keep mentioning the Viatron fiasco when the PET is discussed, saying that this whole thing smells exactly like it. Will Commodore really produce and deliver the PET?

Karush: Yes. The models we had at NCC, for example, were not made on a production line, but they were made from production *plans*; they are real production prototypes and they work.

Personal Computing: Chuck Peddle has made a big point of vertical integration as a necessity for inexpensive production of a computer like the PET. Since the cost of the microprocessor is only a fraction of the cost of the computer, is Commodore really reducing its costs significantly in owning MOS technology?

Karush: Oh yes, Commodore buys a lot more than the 6502 from MOS Technology. They buy RAM and ROM and other support chips, too. I think the cost advantage is really important.

Personal Computing: Do you think competition will develop quickly?

Karush: Yes, but I think it will be a matter of months, perhaps a year. Probably some copanies like TI will come in with products for the small business market that can be scaled down in price and performance for the consumer market. That's the opposite approach from what Commodore is doing. In the meantime, the PET should become very well established.

Personal Computing: And what will you be doing?

Karush: Myself? Oh, I'll be around in the business. We'll keep in touch.

JOHN PEERS

John Peers, proprietor of the ADAM computer system, is widely known as an interesting and controversial prophet in the computer field.

Personal Computing: Do you think the PET is significant?

Peers: Oh yes. Assuming, as you say, that it is real, it is highly significant. There's no doubt of its success. Of course I believe that within the next decade computers will be produced in greater quantity than motor cars.

Commodore has chosen a very interesting approach. As far as we can tell, they are proposing to retail the PET cheaper than industry can buy such a system in quantity. They are pricing it at the level it should realistically reach in two years.

Personal Computing: Why?

Peers: It scares the competition off while the PET becomes firmly estab-

to improve her marriage. We're going to put a series of marriage tests and counseling on machines, a very, very important item. Look at the number of women's magazines that give tests and things like that, and tell them what to do. One of the first applications that we're going to put on the machine is a marriage test that is normally given by professional marriage counselors. You take it and your husband takes it, and the machine tells you, based on normal psychological data (this is not a machine being any smarter than the psychiatrist who set it up) will tell you where you have areas where you need to make improvements . . . how you viewed yourself and your husband viewed himself . . . how you fare against reasonable norms. And this is a private thing, a one on one thing. Computing is something you can control . . . it gives them control in a society that is highly mechanized.

Personal Computing: Does your mass market seem to have a need for greater personal control?

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lished and can really begin to earn money as costs drop.

Personal Computing: Is the product really made to sell, apart from price?

Peers: Yes, it's the right package, a good design. Of course, it is merely a step in the right direction. Computers must change greatly to become proper tools for people. The rules of programming must be taught to computers, not to human beings, so the computers can figure out for themselves how to do what people want to have done.

Personal Computing: You're not a true believer in BASIC or any other existing computer language?

Peers: That's an understatement. Our present methods will pass. The PET will help us move along our way. It's important that some company with resources, like Commodore, bring such a system to market. They must be able to persist while the product gains acceptance. One concern in the small computer market is that so many operators are good technicians, but not good businessmen.

Personal Computing: Whom do you see as competition?

Peers: People already in consumer markets . . . companies like Tandy, General Electric . . . the Japanese . . . people who have professional distribution.

Personal Computing: Does Commodore seem to have a clear, straightforward plan for getting this product out?

Peers: I don't know that much about their plan, but I imagine that you will see a number of sharp changes in direction as they learn from experience. This is a new product. Nobody really knows what will work, and I expect sudden changes to occur.

Personal Computing: Will the major computer companies be much interested in this activity way down at the bottom of the computer field?

Peers: If I were a major computer manufacturer, an established dinosaur, I'd be terrified.

PAUL TERRELL

Paul Terrell is the entrepreneur behind the now-international chain of computer-retailing Byte Shops.

Personal Computing: Are you planning to carry the PET in the Byte Shops?

Terrell: Well, the PET or something very much like it. It depends on what sort of deal we might be able to make with Commodore which has its own approach to marketing. If the PET does what they say at the price they are talking about, it is very important and other manufacturers will have to follow with competetive products.

Personal Computing: Is price the primary consideration?

Terrell: The price is important, but it's only part of the story. I'll tell you what . . . a picture is worth a thousand words . . . that's the old saying, right? Well that's what's really significant about the PET. Graphics is the greatest thing about it. The first time it had any real impact on me was when I saw the array of images on the PET screens in their brochure . . . the business graphs, card games, nice pictures of all kinds. I saw that and I just had to have one. That's how it hit me.

BOB ALBRECHT

Bob Albrecht has made a profession in the last few years of turning people on to computing by helping them play with computers so they're at ease with the machines, by publishing, speaking, teaching and starting things up. He's become a major figure in education for personal computing.

Personal Computing: Assuming that the PET is for real, are you glad to see it arrive?

Albrecht: If it's real, it's what I've been waiting for for fifteen years. It has enough real capability so that it doesn't just demonstrate a few basic principles, but lets the user do interesting things . . . and the cost is low enough so that schools can buy PET systems out of operating funds without having to go to the board for approval. Cost is the key.

Personal Computing: You think the use of the equipment is affected by its cost? Apart from function?

Albrecht: Oh yes. The PET and systems like it can now be treated as "open access" equipment in learning centers (which used to be called "libraries") where the kids can use the machines themselves. I have a program going for just such use of computers in which we'll train some kids to operate the computers so they can monitor their use by other kids. We won't bother to train the teachers. It's like training a few of the students to use standard audio-visual equipment like tape recorders and projectors. They'll make it possible for other kids to use the computers. The real teaching will be a self-training operation, once they know how to turn the computer on and off and make it operate basically. Students will teach themselves how to do things with the computer. For the first time, now they

Peddle: They're taking away all the fun things in life. You can't drive your car any more, because you're taking too much gas. I can't even wash my car, because we're running out of water. This is the front edge of a revolution that allows people to have more control of their environment. It's as clear and simple as that. I sound like I'm a deep-thinking social reformer, but I'm not. I plan to make a crassly commercial business out of this thing. It's only because of crass commercialism that I can buy a digital watch for nine dollars, or a scientific calculator for twelve dollars. Five years ago a calculator used to sell for two thousand dollars and you couldn't buy a digital watch. It's that kind of commercialism, of putting it in the home, of making it available, that in fact is going to make this thing a revolution.

Therefore, it's got to be commercially viable. It's a matter of making sure that once you get the computer in the home, you support it, making sure that the customer can buy a continuing set

may be able to use the same computer at home that they have at school. They can carry the tapes back and forth.

Personal Computing: Will there be software available for this kid-stuff right away?

Albrecht: I'm going to be writing a lot of this material – books, articles, manuals in the next year.

Personal Computing: Specifically for the PET?

Albrecht: Yes.

Personal Computing: Subsidized by Commodore?

Albrecht: No. I haven't even talked to them. This work will be entirely independent.

Personal Computing: What if they can't deliver the PET, or anyway, don't put

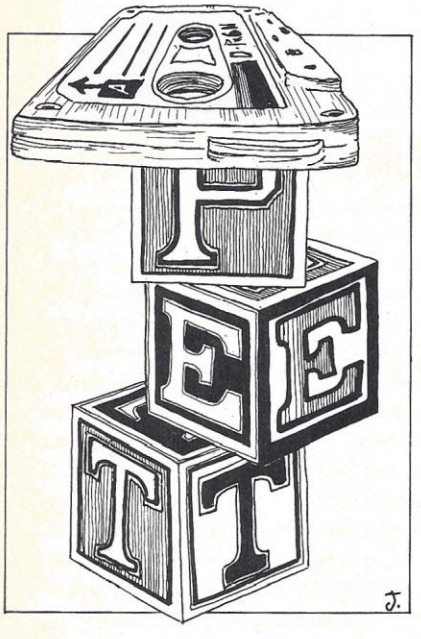

Illustration by J Porter

machines in significant numbers into the educational area in the next year or eighteen months?

Albrecht: Well, *some*body will supply a machine of this class at the right price. It's exactly what we need.

JEF RASKIN

Jef Raskin is a widely-known commentator in the personal computing field, with hard-won technical credentials that give uncommon weight to his views. He visited Commodore for Personal Computing to examine what he cynically expected would be a toy.

Prototypes of Commodore's $595 "Pet" computer have been seen at a few of the more recent computer shows, such as the West Coast Computer Faire in San Francisco. The concept of a one piece computer with CRT screen, keyboard and cassette recorder is permeating the industry. When the Pet is turned on it is immediately ready to run in BASIC. No tapes to load, no magic incantation to type. That is because the Pet has BASIC in indestructible read-only memory (ROM). Very convenient, and you can't lose BASIC no matter what you do.

But just how good a machine can Commodore make for the price? Personal Computing went to the Palo Alto, California headquarters of Commodore to find out.

The Pet is no longer a rumor. While production quantities are not yet available, a number of prototypes are running. The Pet is a little bit reminiscent of the Lear Seigler ADM-3 terminal or the APPLE II computer in that it is a one-board machine. The boards are in production. The cabinet, which would be at home on board the Enterprise, is in tooling, and will be ready by the time you are reading this. The prototypes are operational, and the BASIC software is debugged and runs very well. In this case "very well" is almost an understatement. But more on the BASIC later.

As has been pointed out, when the Pet is turned on it comes up automatically in BASIC. The screen is very clear and has 20 lines of 40 characters each. This is, perhaps, a better compromise than the usual 16 lines of 64 characters. Graphics of a limited sort are achieved by a rather clever set of special graphics characters. These are intended more for creating drawings by hand than for program controlled drawing, although clever programmers will soon discover how to do what they wish with it. Experienced computer users would probably prefer a co-ordinate drawing system such as the one provided on the Polymorphic Systems' Poly-88. Considering the cost of the Pet, any graphic ability at all is impressive, and the way it has been implemented is easy for a beginner to grasp. And the Pet was designed for beginners in computing. Not for the Old Timers.

The weakest part of the Pet is its keyboard. If you know how to type it is a disaster. The keyboard is dead flat, with almost no key feel. While the letters of the alphabet are in their normal order, the rows of keys are not staggered as on a typewriter, but in a rectangular array. They are also quite small, and to get up any speed will take practice. The special characters are scattered about in defiance of the usual conventions. If you wish to use upper and lower case (as in text editing) you will have to get used to shifting for lower case. There is no

of capabilities. You must be able to buy software. We're going to be in the publishing business, and so are a bunch of other people. Buying software tapes is going to be as easy as buying John Denver tapes. Buying instructional manuals to go with your language course will be automatic . . . it will change the public reading and buying habits.

Personal Computing: And television watching habits?
Peddle: That's right. Absolutely!
Personal Computing: Do you think the television companies will see that?
Peddle: No, the only guys I see with that thinking are the cable TV people. I don't think the regular television people will catch on to it at all. I'm not saying television is going away; I still can't show NFL games on this thing . . . but people are beginning to read again. This gives them a reason to read.
Personal Computing: You don't expect to be alone in the business.
Peddle: The entrepreneurial opportunities this business will create will be the

Continued on p. 40

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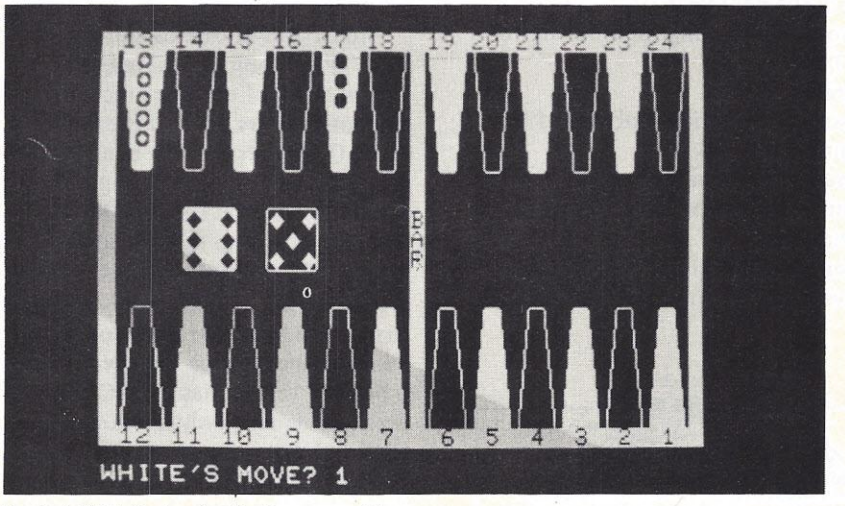
shift lock. Since the keyboard is unencoded (the keys are recognized by the software in polling operation) experienced hackers will easily be able to hook up other keyboards to the Pet. It is hoped that Commodore will provide a good keyboard at least as an accessory, if not as an option.

Since the Pet is a one-board machine, it cannot accept the wider range of accessories available for the S-100 bus machines (such as the IMSAI, Poly-88, Sol or ALTAIR) or any other devices that expect to plug into a bus. It does have an IEEE-488 interface as a standard feature. Commodore plans to bring out a printer and perhaps even a modem that will interface via this port. In addition to the built-in cassette unit, the Pet also has a second cassette port to allow use of an outboard recorder. While Commodore emphasizes that this machine is for the mass market, to be sold through stores such as Wards, Sears or JC Penney's they seem to have taken some care that it will be usable in a wide variety of more sophisticated applications as well.

There is a special feature of the Pet that makes servicing potentially trivial, at least on the board replacement level. When a service person gets a Pet that has a problem he can run a special program that checks all the sub-systems on the board, and if they are all OK it lights an LED. The system isn't totally self-diagnosing but this is an important first step towards improving serviceability. Expect to see other makers following Commodore's lead.

The BASIC that comes with the PET is definitely one of the best to be provided with any personal computer. Written by Microsoft (who wrote the original ALTAIR BASIC and who seem to be improving with experience), it is fast, has high precision, and useful features. One of the best features is graphic editing. The programmer can move the cursor up, down, back or forth to insert and delete characters in any BASIC statement on the screen. An incorrect line can be fixed without having to retype the entire line. This one feature alone makes the Pet stand heads and shoulders above any other personal computer in ease of program preparation.



Typical CRT display for Backgammon Game.

All the now-standard statements and functions of personal computing BASIC are included. PEEK and POKE are there; all the trigonometric fucntions, good string handling, multi-dimensioned arrays, and a real-time clock are built in. All the special graphics characters are accessible from BASIC, as are the cursor commands. There is a special key that pulls in a tape and executes it for game players that don't want to know even how to type RUN to get a program to work. You can program the Pet fancy or simple. It's all there – as far as BASIC goes.

Memory expansion is limited and expensive. The Pet comes with 4K bytes – all of which is available to the user, since BASIC is on ROM. An additional 4K can be ordered in the same unit but this brings the price up to $795. This is pretty expensive for 4K and the knowledgeable user may find it cheaper to buy chips and put them in. To go beyond 8K, an external box is necessary, since after 8K the Pet is running out of both room and cooling ability. It neither needs nor has a fan. This keeps it quiet.

The Pet, says Chuck Peddle of Commodore, is above all a personal computer. At $595 it costs less than most CRT terminals without a computer! It is expensive for a toy (but not all that expensive these days) but very inexpensive for the capabilities that Commodore has built in. Except for the keyboard, it is a well-built, human engineered machine. The Pet should appear in thousands of homes, schools and businesses (this last as soon as the printer is available) and, with luck, make a major contribution to the spread of personal computing. ■

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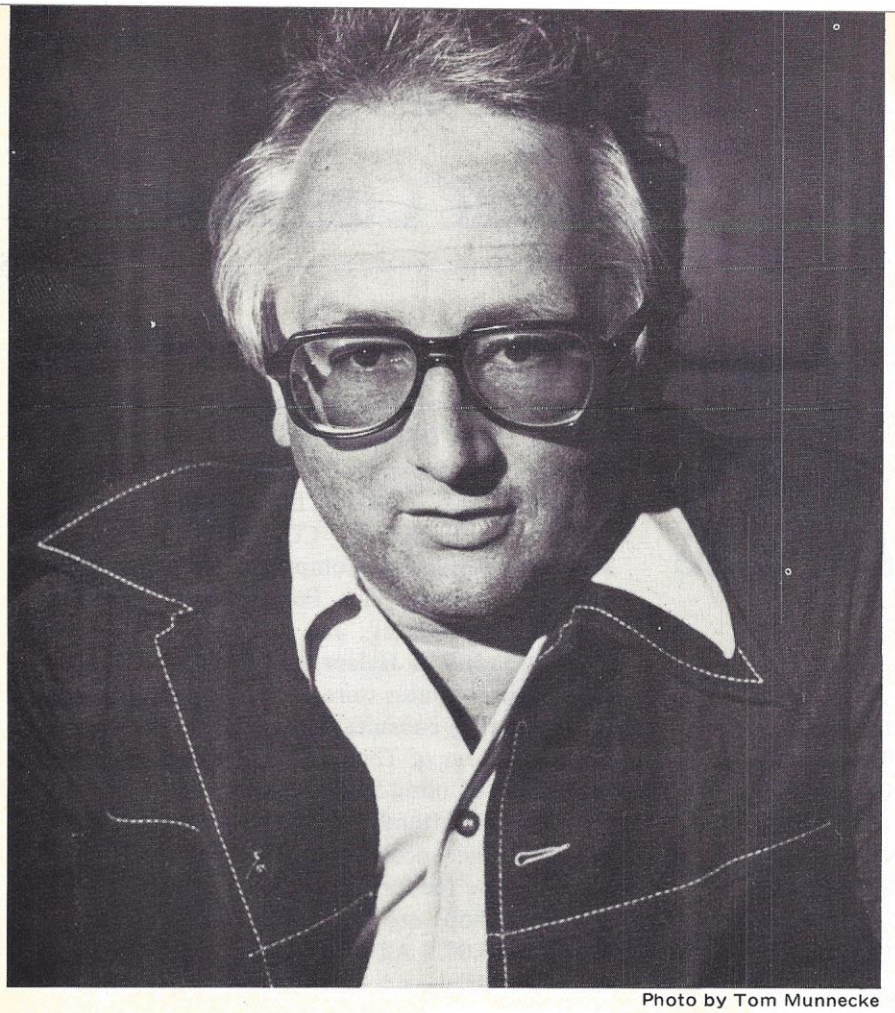

Photo by Tom Munnecke

revolution of the 1980's.

Personal Computing: Whom do you see as competition?

Peddle: National Semiconductor, Texas Instruments, maybe Intel. You need to be vertically integrated . . . Hewlett-Packard and Tektronix, maybe. IBM, of course, if they choose.

Personal Computing: How do you see the product being retailed?

Peddle: This product is designed to be retailed by a normal retailer. The machine will basically demonstrate itself; it shows itself, sells itself. A guy has got to be there to communicate with the customer, to show him how to do some mundane things, and to make sure he buys the correct complementive product. It's like selling stereos. There will be people who are experts, and they will sell the more sophisticated systems . . . certainly the system for the doctor and small business systems . . . things like that will be sold by specialists. But the basic hardware of the standard customer will be sold by retailers without any technical training.

Personal Computing: What about peripherals for this system that aren't now being offered?

Peddle: That's just a matter of time.

Personal Computing: What about floppies?

Peddle: Floppies? Easy. It's built into the structure.

Personal Computing: How much would it cost?

Peddle: I want to see a floppy retailed some time at $400. Right now it's about $1000 . . . with all the controllers and everything else. A lot of people are talking about $400 floppies, but they don't do anything. When we sell a product, it can be used by the consumer . . . it will be no more trouble than plugging into the wall.

Personal Computing: Realistically, what percentage of your customers will program themselves?

Peddle: To begin with, very few. In the long run, as we discussed, I think, everybody in the United States.

Personal Computing: Everybody will be Programmers?

Peddle: No, programmers, with a little p. At the turn of the century how many people could read or write? There were Writers and Readers, professionals. There will be professional Programmers, just as there are professional Singers. I may hire a Singer, but I also sing. I will program a machine as a normal human being.

Personal Computing: What's your background, personally?

Peddle: I'm an engineer by training, been in computers since 1959. I've designed computers and peripherals . . . started a company to be in the intelligent terminal business in 1969, using a microprocessor. That was before anybody had heard of either one of those. We went broke.

Personal Computing: What was the company name?

Peddle: It was called Intelligent Terminal Systems. We started another company using a microprocessor-based system in the word processing business. It went broke.

Personal Computing: Have you learned from your mistakes?

Peddle: No . . . well, the answer is "yes." Never run out of money; that's what I've learned.

Personal Computing: Any other history?

Peddle: I was part of the design team that did the Motorola 6800. I was personally responsible for the architecture.

Personal Computing: What level of architecture?

Peddle: All the way down to the chip design. I did the logic and the basic chip layout, how the chip would go together. Then I went to work for the company that did the microprocessor that's in this product. I actually was the leader of a team of people that designed the 6502. Commodore bought the company and I came to work for Commodore last November.

Personal Computing: Did Commodore ever consider buying companies with existing microcomputer systems in the market, like the Digital Group, and integrating them into the Commodore product line?

Peddle: Of course. Commodore always considers buying companies first, like Apple or something. But the product would still look the same as it does now, rather than like another, because of the consumer orientation of Commodore.

Personal Computing: So you've done the PET? It's a fully committed project by Commodore?

Peddle: Absolutely. We are counting on selling fifty million dollars worth of products next year. ■

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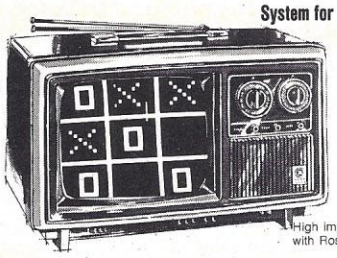

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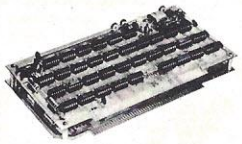

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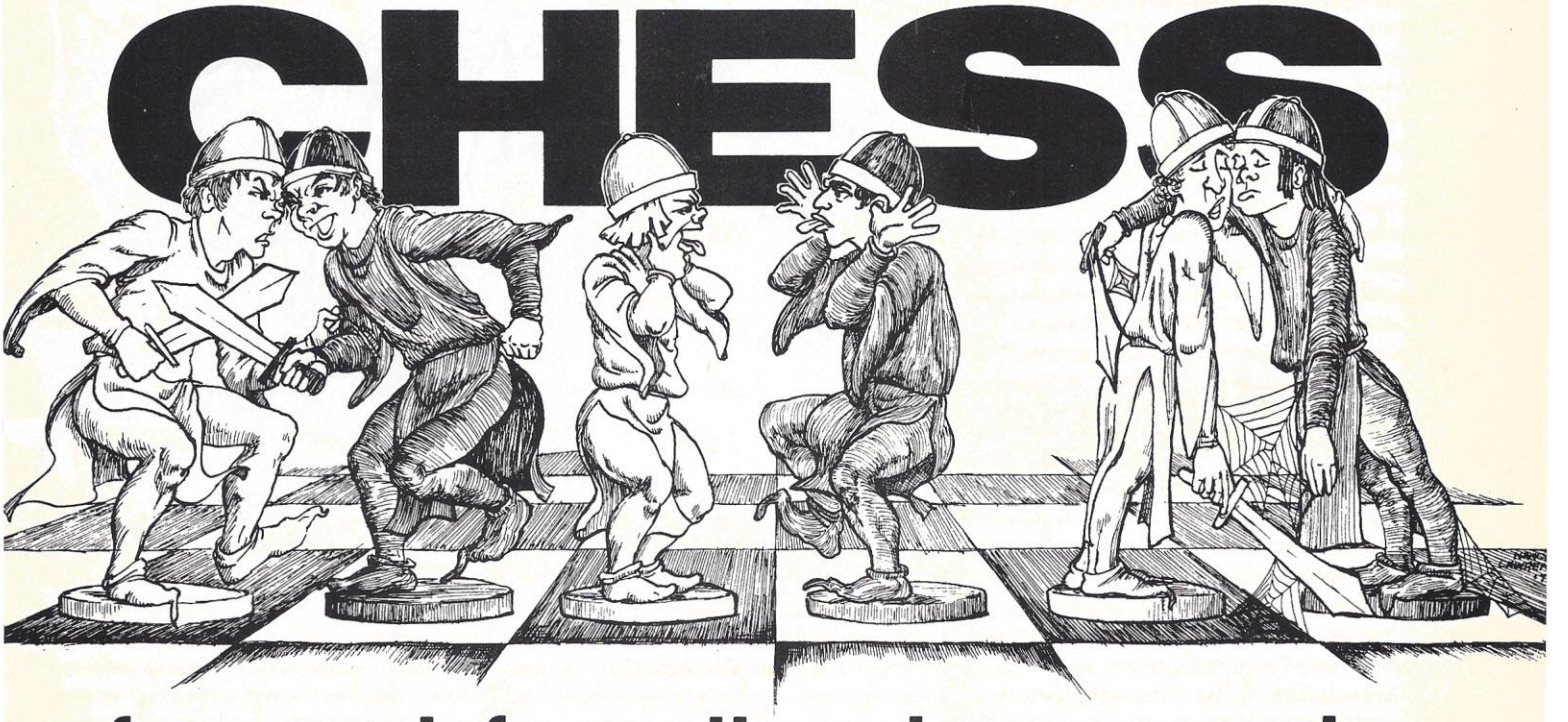

from an information storage angle

by Will Overington

Most people are somewhat familiar with the rules of chess even if they do not know how to play. This article discusses a problem involving chess that may interest computer hobbyists. The problem is to find maximum and minimum estimates, denoted respectively H and L, for the total number, N, of legal chess positions which could occur in the course of an indefinitely large number of chess games. The expression "could occur" is crucial. For example, positions that could occur only by one or both of the players each missing a few check-mates *could* occur. Although such positions are unlikely, they can occur, so N includes them. On the other hand, it is not necessarily correct that any possible positioning of pieces on the chessboard could occur in a game. You may use any method to find the lowest value for H and the highest value for L. Note that by definition the value of N is fixed, but unknown, and the values for H and L are known, but are not fixed. The problem is open-ended of course. We do not have the answer against which to check calculations.

big numbers

Although present and future generations may play an indefinitely large number of games of chess, a finite upper limit definitely exists to the number of possible chess positions. Only 13 possible contents exist for any given square, and so the maximum value for H is twice 13 to the power of 64, or about 3.9×10^{71}, and which could be computed exactly by anyone interested. The "twice" is because "white to play" and "black to play" for the same layout of pieces count as two positions. This number is barely comprehendible – there are far fewer microseconds in a billion years. Our initial value for L is 1 – at least the starting position exists. *So N lies somewhere between 1 and* 3.9×10^{71}.

Consider designing a chess playing machine that encodes any position to provide an address for a read-only memory system which would then output moves. The read-only memory could be programmed from recorded games of grandmasters. The machine would be capable of grandmaster level moves. We might link the system into a computer running a chess playing *program* and allow the read-only memory system to override the program's decision with an appropriate move. This operation could upgrade the computer's standard of play.

Suppose we code the contents of each of the 64 squares on a chess board in the manner shown in Table I, and

TABLE I

0000 empty square	1000 white bishop
	1001 black bishop
	1010 white knight
	1011 black knight
0100 white king	1100 white rook
0101 black king	1101 black rook
0110 white queen	1110 white pawn
0111 black queen	1111 black pawn

then prefix "0" if white is to move and "1" if black is to move. This gives a 257 bit (= 1 + (64 x 4)) input address. Alternately we may choose to use 00 for an empty square rather than 0000 and then close up the gaps to give an address at maximum 193 bits and shorter by two bits for each piece re-

moved from the board. Many read-only memory integrated circuits have 10 bit addresses. To use 11 bit addresses you need two integrated circuits, for 12 bit you need four, for 13 bit you need eight and so on. Using 193 bit addresses would require a truly enormous number of read-only memory circuits. It might be interesting to estimate the size of a printed circuit board for these circuits. Beside demonstrating the impracticality of the read-only memory system suggested above, the exercise may provide a *"feel"* for the problem's complexity.

another approach

Programmed logic arrays are another alternative. The read-only memory system would include addressing logic and storage space for an output word for every position, legal or illegal, that its encoding system permits. The illegal positions would include a large number of ridiculous cases such as positions containing 23 white rooks and so on. Although our 193 bit coding system can code all possible legal positions, the converse, that any 193 bit word represents a legal chess position is *not* true. In fact, it could denote all sorts of things with from zero to 48 pieces and 96 down to 48 squares. Programmed logic arrays would deal only with the legal cases programmed into them. They would require an impossibly large unit to deal with all N possible positions. But, a computer hobbyist interested in electronic engineering could easily, if laboriously, make a circuit that would recognize, for example, the danger of the classical "scholar's mate" occurring. To recognize just one position involves a hardwired logic unit. This and one or two other positions taken from common opening gambits could provide an interesting constructional exercise, although of little practical use due to the large number of logic gates needed for recognizing even twenty positions.

Many positions occurring near the start of many chess games still have the rooks, kings, rook pawns and knight pawns in their original positions. Thus we might be able to "factor out" 56 bits (= 4 x 14) from each position near the start of a game, thereby greatly reducing the number of gates necessary. In operation, the computer program would check the status of a flag to see if the programmed logic array had recognized one of "its" positions, and then proceed

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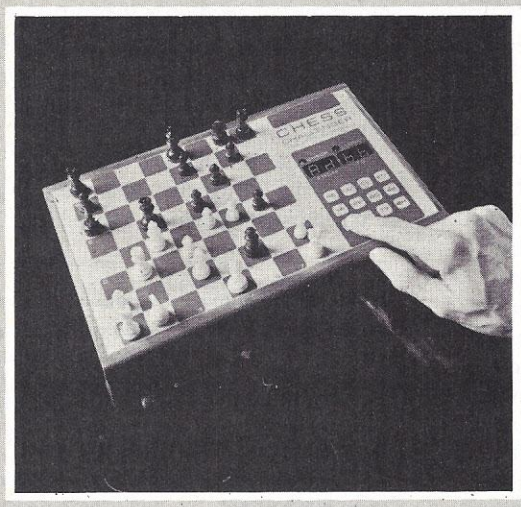

You may now buy a tidy, little, self-contained, chess-playing personal computer called CHESS CHALLENGER. The user plays against the machine, a meticulous average player, and follows the rules carefully. When the user masters CHESS CHALLENGER it can be upgraded with a more difficult program. Those who are not chess nuts may find this a fine way to drill themselves before a scheduled evening of being beaten by a neighbor. (Can't you remember about Castling and En Passant either? This computer remembers all about such moves and will beat the tar out of you repeatedly as an educational reminder.)

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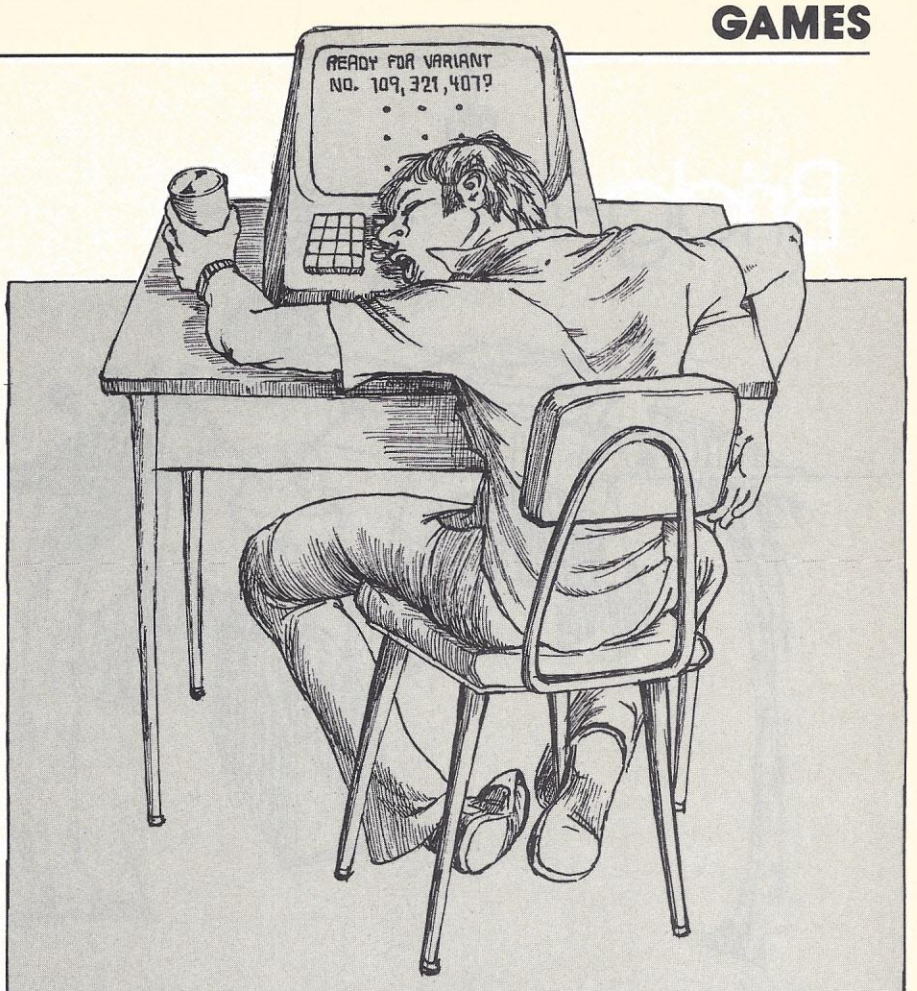
accordingly. You can compare the time taken for checking the status of one flag with the time it would take to check the current position for agreement with one or more 193 bit words using software.

every little bit helps

Note that 2^{193} is about 1.3×10^{58}, a 59 digit number. Thus we have reduced H to less than one millionth of a millionth of its initial value. By choosing a more compact type of coding, yet one still containing all legal positions, we managed to eliminate many possible "ridiculous" situations by treating every square as potentially containing any one of 13 different contents, disregarding the contents of other squares. A form of coding that eliminates a few more "ridiculous" cases could allow us to further reduce the value of H. N will ultimately limit the number of bits necessary for coding a chess position. The shorter the coding, the more complicated it probably will be to interpret. The original "four bits per square" coding in the table is very simple, but it needs 257 bits. The choice of coding depends on the application.

simple complexity

This article intends to prompt thought about the vast information content that can spring from a simple basic structure, such as the rules of chess. By trying to devise a code that can express *any* given chess position in fewer than 193 bits you will perhaps make some interesting discoveries about coding – remembering always that pawns may be "queened" for any chosen major piece except a king. And don't forget to think about how you could raise the value of L without counting any position twice. ■



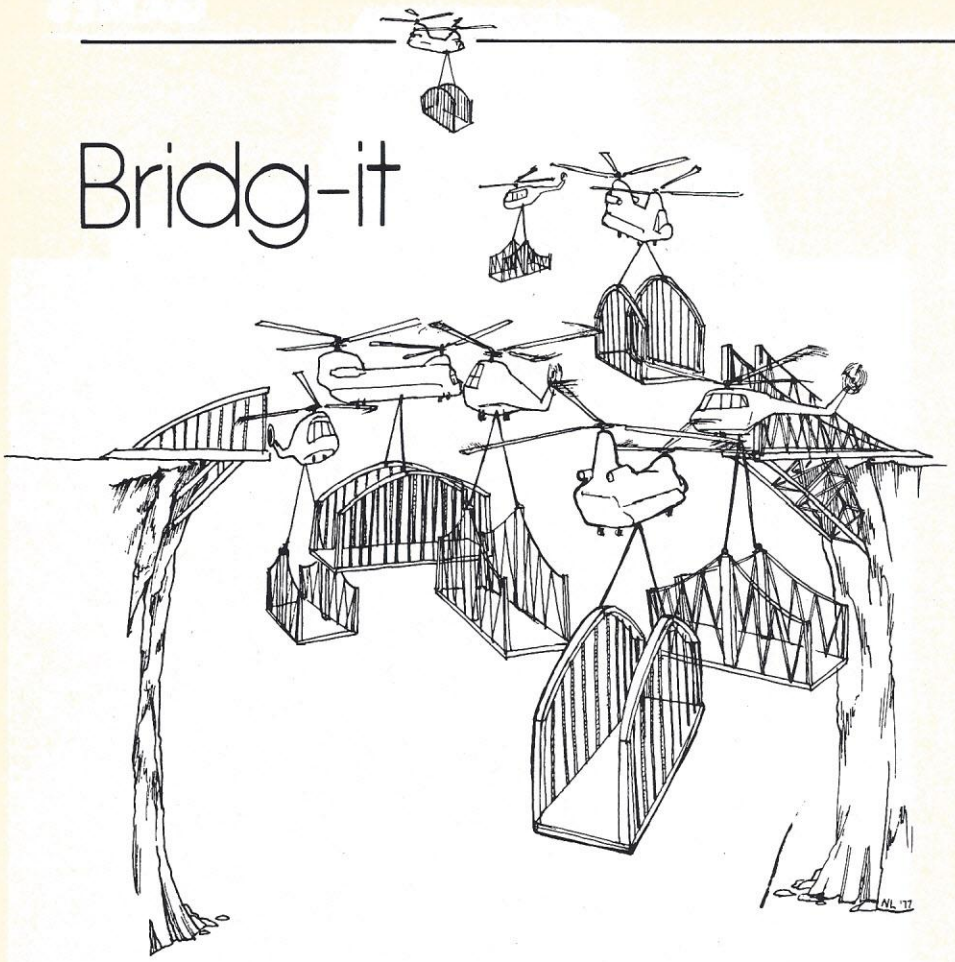
Playing Against the Computer

Games with Finite Solutions

Games attract programmers – we've seen this ever since the days of vacuum tube computers. Two player pre-set games form one branch of the game tree. These games have finite solutions; if played right, the result is a foregone conclusion: either the player going first will win, the game will end in a draw or whatever. Games such as tic-tac-toe and Nim are well-known examples of two player pre-set games; others, complex enough to defy a quick analysis, include Bridg-it, Black Sheep and Initials. These three games offer a real challenge; all adapt readily for programming.

by David Galef

Bridg-it



Bridg-it, as a board game with plastic pieces, was put out by Parker Brothers some years ago. Mathematics professor David Gale developed Bridg-it, which was described in the October 1958 issue of *Scientific American.* The set-up is easily drawn and can be transcribed for computer use. On paper, the board is a series of X's and O's, alternating in rows of five and six (see diagram A). The game's object is to stretch a bridge from one side of the board to the other while blocking your opponent from doing the same thing from top to bottom. One player uses the X's as connecting points; the other player uses the O's. Diagram B illustrates a finished game.

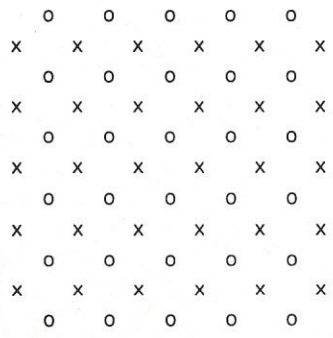


Diagram A
Bridg-it board.

For some time, the end of the game was unpredictable, and the only available game programs tried to account for all the possibilities. Then, about three years after the game's development, a solution was found which guaranteed that the first player would always win proving that the game had a definite solution. The winning strategy, proposed by the game's expert, Oliver Gross, was surprisingly simple: the first player moves in the lower left-hand corner; for the following moves, whenever the second player crosses a dotted line, the first player merely makes his play by crossing the other end of the line. Diagram C shows the dotted lines to be drawn and the method of play. This tactic will win every time, though not necessarily in the fewest number of moves. Curiously, the better the opponent plays, the more graceful the win against him. If the first player follows the winning strategy exactly, the opponent's inept play will produce equally awkward responses, but the first player player will win regardless. The game is intriguing, and with the finite solution available, Bridg-it should be easy to program.

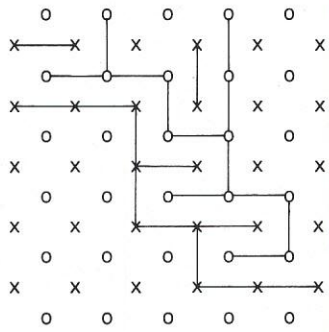


Diagram B
Bridg-it: Player going across has won.

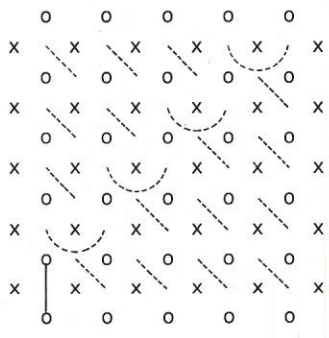
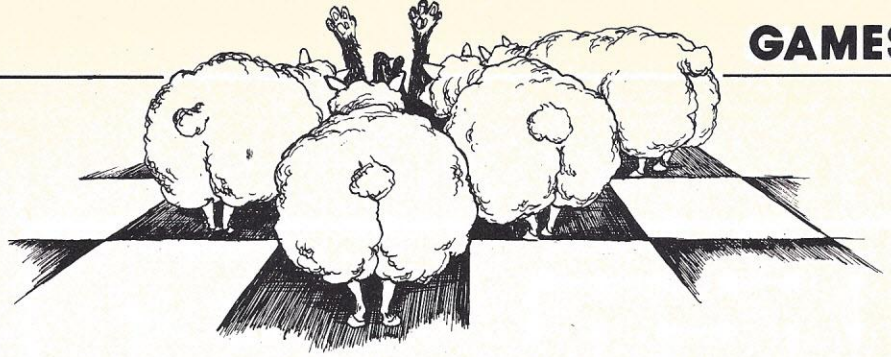


Diagram C
Bridg-it: Winning strategy.

Black Sheep

Black Sheep is played on a checkers board. It consists of four white pieces against one black piece, and the basic strategy involves surrounding or cornering the black piece. All the pieces move like checker pieces. The white side may move only forward, only on a diagonal, one square at a time, while the black piece may move one square forward *or* backward on the diagonals as a king in checkers moves. The starting position is shown in Diagram D; the black side moves first, and the moves alternate. There are no captures. When Black comes up against a row of white pieces, he will be forced to move backward (see Diagram E). If Black manages to slip past the white blockade to reach the other side of the board, he wins, since White can-



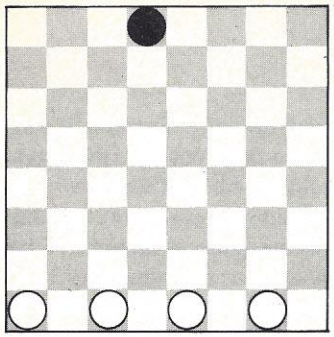


Diagram D
Black Sheep: Starting position.

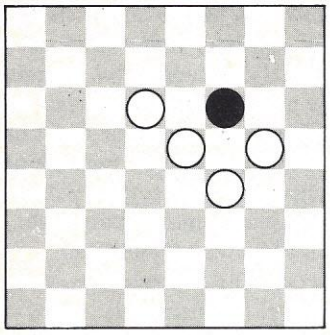


Diagram E
Black Sheep: Black, opposed, must move backwards.

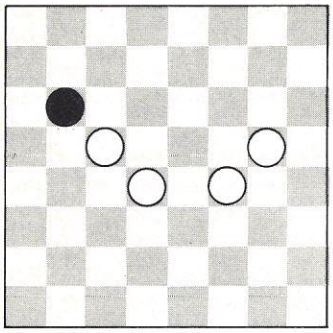


Diagram F
Black Sheep: Black to move – can make his way forward to the edge of the board, where White cannot stop him from reaching the other side.

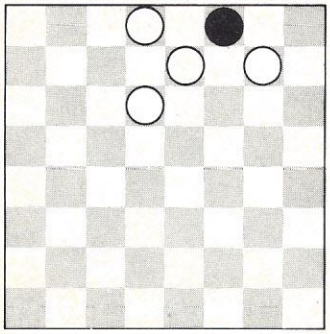


Diagram G
Black Sheep: Win for White.

not travel backward to stop him. White usually wins by surrounding Black at the edge of the board, though the win can occur in the middle of the board. Diagram F shows how Black can win, while Diagram G and H

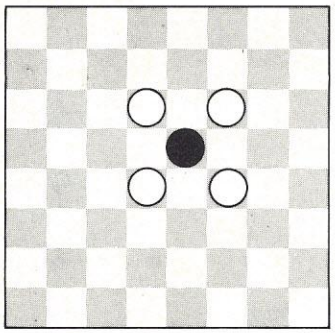


Diagram H
Black Sheep: Win for White.

demonstrate wins for White. Despite the game's apparent complexity, Black Sheep leaves only one finish possible between two experienced players. White, with his superior numbers, invariably will be able to neutralize Black's greater mobility, and the game should end in a win for White. Interested programmers trying to adapt Black Sheep for computer play can, of course, program the computer to play either White or Black.

A note of forewarning, however: though the programmer can eliminate an enormous number of side variations by programming the computer to deal with trivial and mirror positions – thus making good use of computer memory – the number of eventualities can be quite large, depending on the level of play desired. The proper method of programming, therefore, would include finding a mathematical formula for White's winning strategy and another formula to describe Black's best line of play. As yet, though, no one has come up with the formulas. One way to approach the problem without the definite solution is simply programming the computer to account for a certain number of eventualities and leave the rest to be decided by a simple algorithm, based on the general pattern of the pieces or even a random move basis. This method requires much less work – and might make the game more interesting to a player who then can beat the computer.

Initials

The last game, certainly familiar to a great number of grade students, is Initials. Also known as "Dots," students often play this game on a scrap of paper during a tedious class. The board is square array of dots. Each player, in turn, draws a line to connect any two adjacent dots – no diagonals allowed. As the game continues, the lines begin to form structural patterns. Diagram I shows a game in progress. When one player draws a line that makes an open box (see Diagram J), the opponent, for his move, draws the box closed, initials it to show it is his and makes another move. Play continues as before until the same situation happens again. The object is to get as many boxes as possible initialed for oneself before the board fills and becomes an initialed grid. Another rule necessary to keep in mind is that, should one player draw a line so as to open a series of boxes that can be filled, the opponent continues drawing line after line, provided each one completes a box, until he can go no further. He then makes the customary additional move and play proceeds. Diagram K illustrates this process. Although Initials has been around for quite a few years, no fixed strategy has been formulated. Even though you can change by using fewer dots, thus

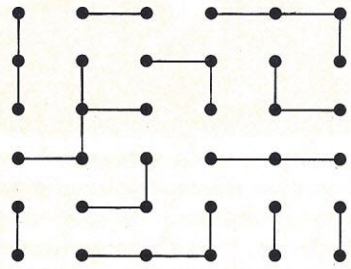


Diagram I
Initials: Game in progress.

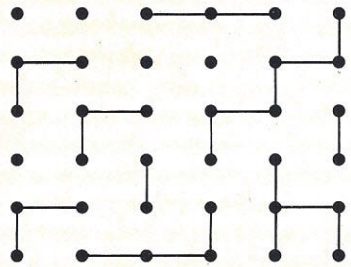


Diagram J
Initials: The player on the move fills in the box in the lower right-hand corner and makes another move.

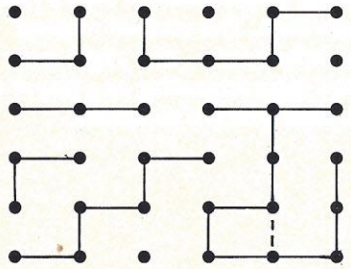


Diagram K
Initials: The player on the move begins filling in the figure in the lower right-hand corner at the dotted line and continues until he has filled in four boxes and made one more move.

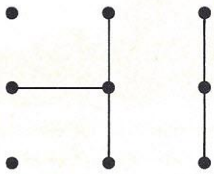


Diagram L
Initials: Win for first player – now the player on the move – on reduced board.

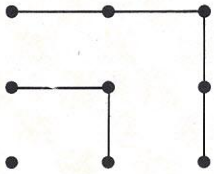


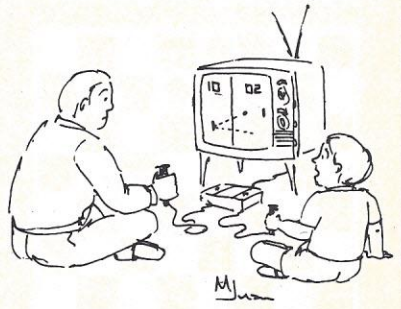
Diagram M
Initials: Alternate win for first player (player on the move).

Diagram N
Initials: Game #1 is a turn-around variation of game #2.

altering the size of the square, all variations of this game must have a finite solution. (It is probably some tactic similar to copying the opponent's every move in a particular area of the board).

One easy way to avoid the complexities of programming the computer to deal with a staggering number of Initials positions is to teach the computer to play a smaller version of the game. A square nine-dot board can still be quite challenging to work with and yet fits much easier in a program. To date, the nine-dot square is assumed to be a win for the player who goes first, but no proof has been shown for this outcome. Diagrams L and M show two positions the first player can achieve, both of which win. Because the board is square, the number of possible games is diminished by a factor of four; the symmetry of a square makes three out of every four games turned-around copies of the fourth game, making programming simpler. Then, too, the number of first moves is only two, since every other first move on the board is either a turn-around or mirror variation of the original two (see Diagram N). Surprisingly, the game remains somewhat complex. Even with only nine dots and a four-fold symmetry to limit the possible different moves, the number of unique games remains quite high: 12!/4 or 119,750,400 possibilities.

The list of finite-solution games is quite long. Unfortunately, many of the games available have trivial solutions and cease to be interesting after a simple analysis. Games like Bridg-it, Black Sheep and Initials, however, will continue to intrigue people , especially home computer enthusiasts, for years. For those of you who quail at the thought of trying to set up a perfect game program, remember that the computer need not play perfectly. For any of these games, the computer can have quirks and random possibilities built into its playing style to liven up the game – and greatly lighten the load on the programmer, who no longer need account for all the right moves in all the situations. The study of preset games properly belongs in the domain of the computer as a tool, as a mathematical exercise or just for idle amusement. ■



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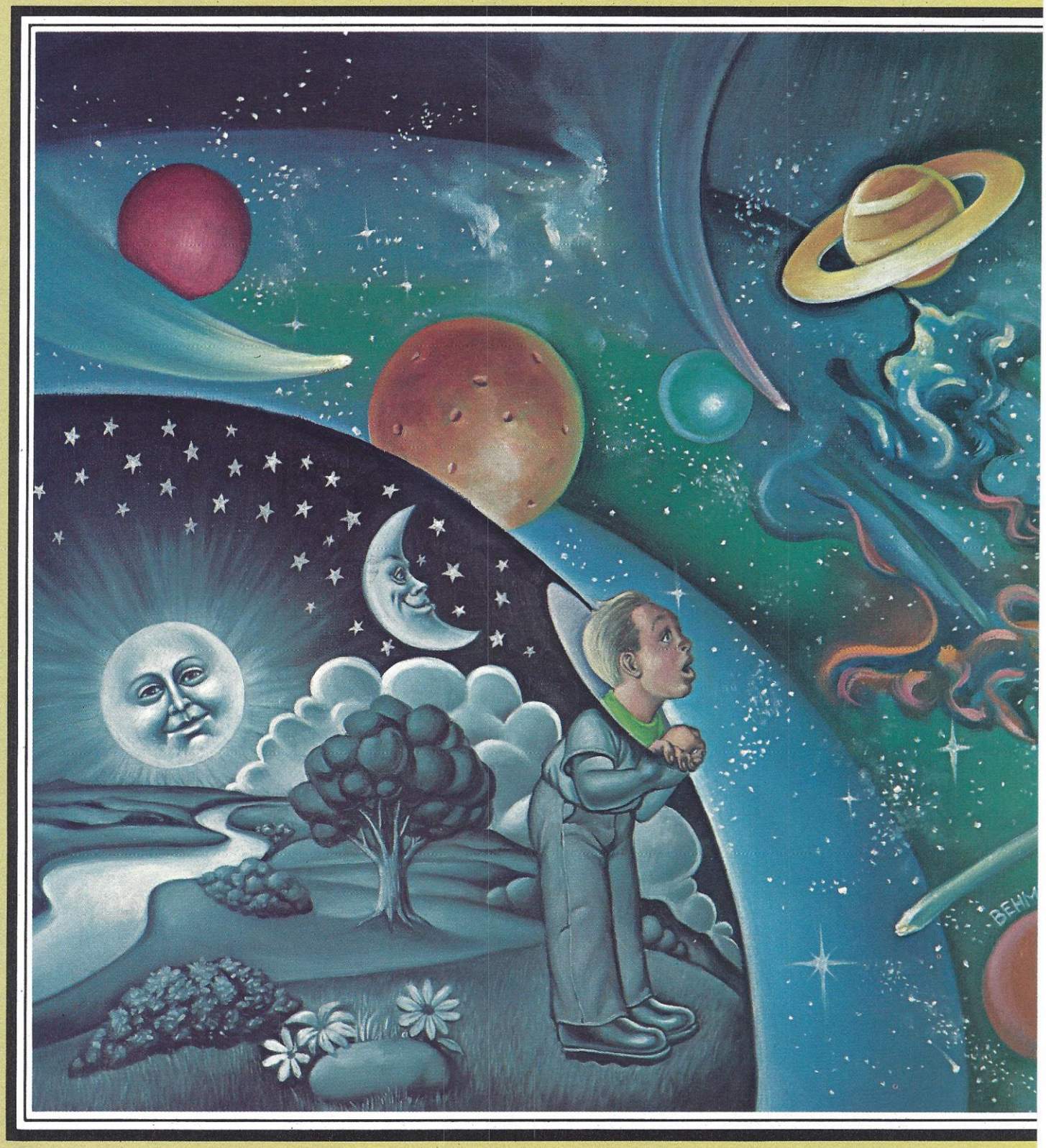
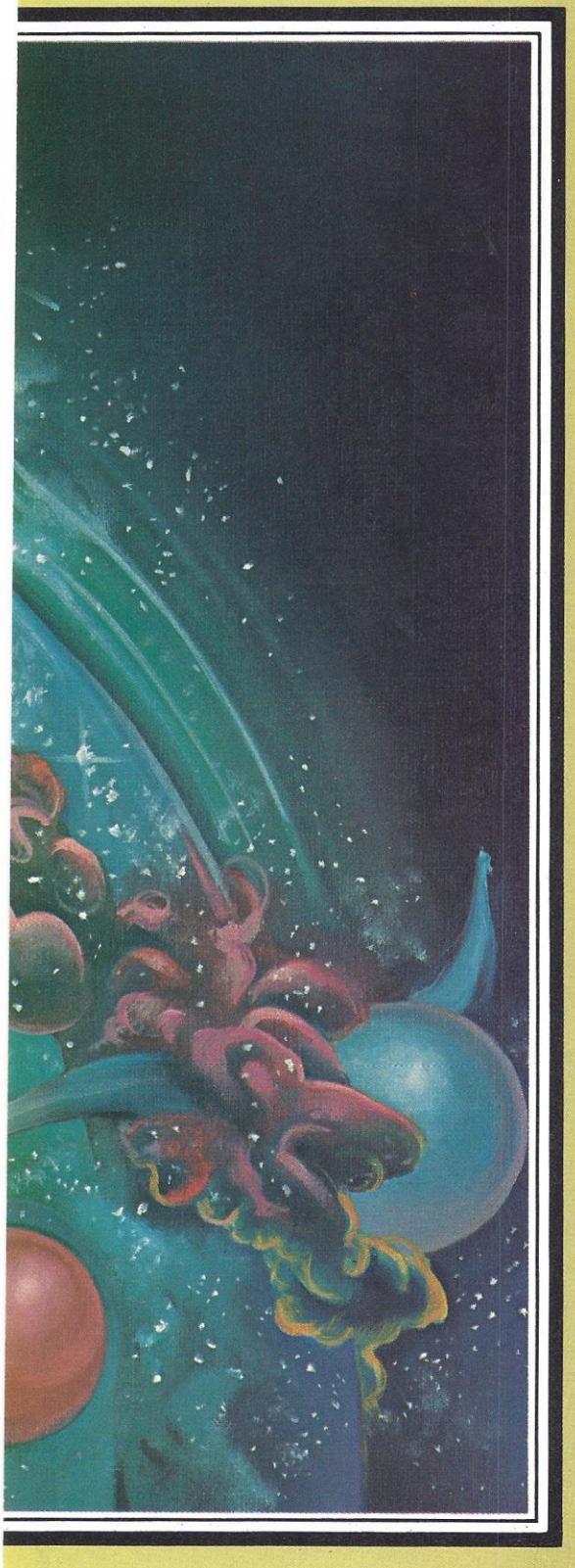


EXPANDING YOUR GALAXY



by **Grady Ward**

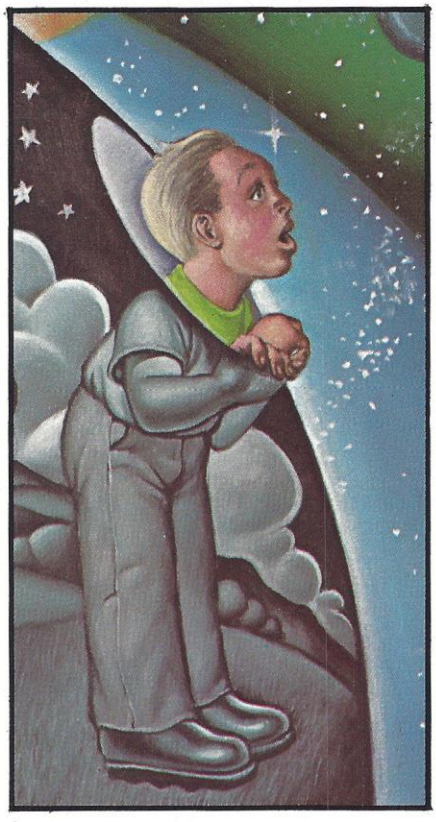
You have played 32,767 games of Star Trek and the next game will just be a bit too much. So you've decided to write your own version with some extra features, such as a 100 x 100 galaxy and efficiency ratings for each ship. You want each sector to contain two information elements: (1) the kind of unit (if any) at that location, represented as an integer from zero to four (0=empty space, 1=star, 2=Klingon Battlecruiser, 3=Romulan Warship, 4=Starbase) and (2), the efficiency of the sector is represented as an integer from zero to ninety-nine.

So you type in 10 DIM G(100, 200), promptly intending to use one row and two columns to store the information for each sector. Hmmm . . . that looks a little big, so you try it out by typing an END statement and RUNning. Through your misted eyes you see: OUT OF STORAGE IN LINE 10. You've exceeded the maximum program size allowed by a factor of perhaps twenty.

Well, don't give up hope yet. Here are two tricks to let you build your galaxy after all and help rid the universe of a few more alien warmongers. The tricks are field-packing your data and using a dense matrix.

Packing your data is doing what the name implies: storing two or more types of information (e.g. object type and object efficiency) in a single number. After packing your sector info for a Romulan Warship with an efficiency rating of fifty-eight percent, you come up with the number 358. You create this number by multiplying the sector type by 100 and adding the efficiency.

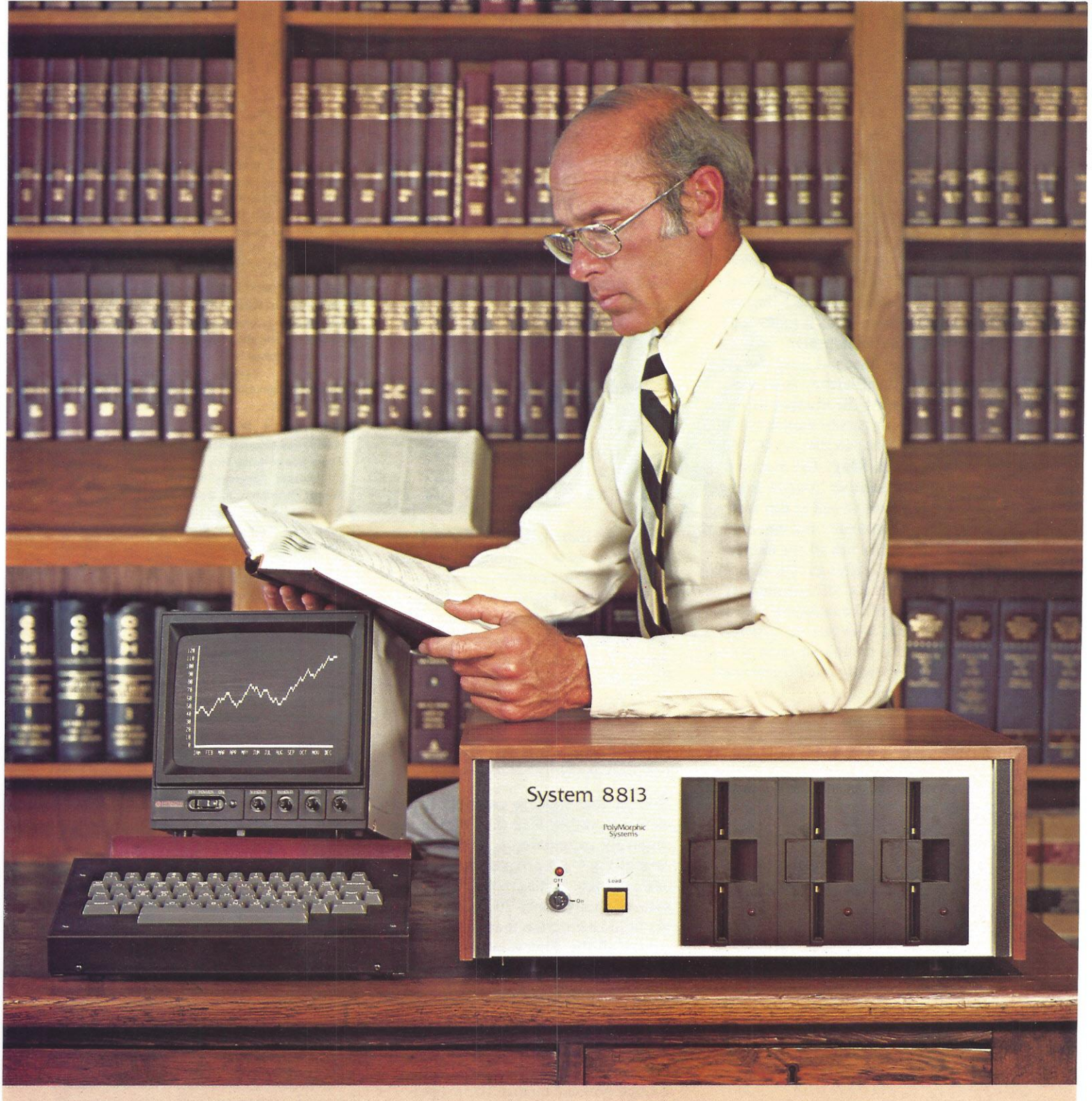
LET P=T*100+E. P is the packed sector element, T is the sector type and E is the efficiency of the unit in



that sector. Reserving a certain number of digits, or fields, for each kind of sector information is known as field-packing.

You know the efficiency never goes over ninety-nine percent (you designed it that way), so you are safe from field overflow, safe from the kind of mysterious metamorphosis you get from assigning your Romulan an efficiency rating of 100, which instantly creates a Starbase (with an efficiency of zero). To retrieve either the sector type or the efficiency from the packed number, you use a judicious combination of the INT and MOD functions. To find out what kind of sector you are dealing with, divide the packed number by

```
 run
STREK      5/31/77    14:30

galaxy created
there are 28 objects in the universe
you have  6 starbases  6 klingon battlecruisers, and
 7 romulan warships among  9 stars.

here is a dump of their positions:

x-y coordinates        type of object
   100,100             klingon cruiser
    88, 64             star
    60, 71             starbase
    81, 36             romulan warship
    93, 43             klingon cruiser
    83, 47             star
    60, 84             star
    58, 61             star
    77, 81             romulan warship
    52, 98             romulan warship
    22, 41             klingon cruiser
    15,  7             romulan warship
   100, 18             klingon cruiser
    80, 18             romulan warship
    80, 43             starbase
    91, 60             klingon cruiser
    40, 53             romulan warship
    39, 84             star
    22, 82             star
    34, 70             star
    69,  1             starbase
    71, 71             romulan warship
    14, 81             starbase
    46, 15             starbase
    60, 57             star
    82, 96             klingon cruiser
    56, 88             starbase
    85, 97             star

DONE

STREK      5/31/77    14:29     PAGE 1

1000  DIM G[297],P$[72]
1010  MAT G=ZER
1020  LET S=K=R=S9=0
1030  LET P=INT(RND(0)*100)
1040  LET P$[1,72]=" "
1050  LET P$[1,4]="star"
1060  LET P$[21,35]="klingon cruiser"
1070  LET P$[41,55]="romulan warship"
1080  LET P$[61,68]="starbase"
1090  REM      the expresssion 'rnd(0)' returns a number
1100  REM      from .00000 to .99999
1110  FOR J=1 TO 3*P STEP 3
1120    G[J]=INT(RND(0)*4+1)*100+99
1130    REM      g(j) is the packed integer containing the
1140    REM      sector type and 99% efficiency
1150    T=INT(G[J]/100)
1160    IF T=1 THEN  S9=S9+1
1170    IF T=2 THEN  K=K+1
1180    IF T=3 THEN  R=R+1
1190    IF T=4 THEN  S=S+1
1200    REM      keep a tally for each object
1210    G[J+1]=INT(RND(0)*100+1)
1220    REM      pick an x coordinate
1230    G[J+2]=INT(RND(0)*100+1)
1240    REM      ... and the y
1250  NEXT J
1260  PRINT "galaxy created"
1270  PRINT  USING 1280;P
1280  IMAGE "there are",x2dx,"objects in the universe"
1290  PRINT  USING 1300;S,K
1300  IMAGE "you have",x2dx,"starbases",x2dx,
       "klingon battlecruisers, and"
1310  PRINT  USING 1320;R,S9
1320  IMAGE 2dx,"romulan warships among",x2dx,"stars."
1330  PRINT LIN(1)"here is a dump of their positions:"
1340  PRINT LIN(1)"x-y coordinates        type of object"
1350  FOR J=1 TO 3*P STEP 3
1360    PRINT  USING 1370;G[J+1],G[J+2]
1370    IMAGE #,3x3d,",",3d
1380    LET T=INT(G[J]/100)
1390    REM      decompose type of sector
1400    PRINT  USING 1410;P$[T*20-19,T*20]
1410    IMAGE 12x20a
1420  NEXT J
1430  END
```



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100 and keep the integer portion. This number corresponds to the sector type. To find out the efficiency of the sector, MOD the packed number by 100. LET T=INT(P/100); LET E=P MOD 100. If your machine doesn't have the MOD function, then substitute the statement LET E=P-INT(P/100)*100. If you don't have the INT function, the Klingons have already won, since it looks like they wrote your interpreter.

So now you have put both the sector type and its efficiency into one number, reducing the number of columns in your galaxy matrix to 100. You blithely type "10 DIM G(100, 100)" and run it again. Bang! The machine responds with another "out of storage message. It's time to call in our really heavy-duty equipment: the dense matrix.

A *dense* matrix has all the empty space taken out. After all, the information you want is just the location, type and efficiency of the occupied sectors; the empty ones take care of themselves. To see how this technique saves space, look at the following one-dimensional galaxy of ten sectors.

0	199	0	0	0	0	250	0	0	0

In the second sector there is a star with an efficiency of ninety-nine percent and in the seventh sector there is a raggedy Klingon with only a fifty percent efficiency (every other sector is empty). You can see that we wasted most of our matrix by describing empty space. This relatively empty matrix is known as a *sparse* matrix. Since, in a two-dimensional galaxy, more than ninety percent of the sectors are probably empty, using a separate element to describe each sector is extravagant. What if we represent the situation above as:

199	2	250	7

This is a dense representation. For each object in the galaxy we assign two numbers; the first number is the packed type and efficiency for that sector, and the second number is the coordinate of the object. Since every coordinate not included in the dense matrix is defined to be empty, the dense matrix contains the same amount of information as the sparse matrix. In our one-dimensional galaxy example, we save more than fifty percent of the space that our original representation uses.

Back to our two-dimensional galaxy. If our galaxy were inhabited by just four ships and a starbase, described in the following table, how do we use a dense matrix to accurately depict the situation?

x-y coordinate	type of object	efficiency
100, 31	Klingon	99
42, 23	Starbase	58
5, 40	Romulan	35
16, 49	Klingon	67
62, 93	Klingon	44

Our dense matrix is represented as an array with three components for each object. The first component is the packed data giving the type of object and its efficiency in the sector. The second and third components give the X and Y coordinates of the object. Using this scheme, the galaxy matrix looks like this:

299	100	31	458	42	23	335	5	40	267	16	49	244	62	93

You see that we have used just fifteen elements, rather than the 100*100 we originally anticipated – not a bad saving! Fig 4 is a program to create and populate a galaxy of 100*100 sectors, though only 297* elements are used to describe the type and location of all the objects in the galaxy. The number 297 may be adjusted in the DIM statement along with line 1030 to increase or decrease the number of objects in the universe. In this program the different kinds of sectors have an equal chance to be created, though you can change the proportions in line 1120 to build the galactic constituency you want.

If you are really chintzy about space, you can go further with the packing process and pack X and Y coordinates into a single number – saving another 33% in your final galaxy matrix. Or maybe we can pack everything into one number? Well, only Spock knows . . . and remember to ask him how to build a three-dimensional galaxy. The Klingons are waiting.

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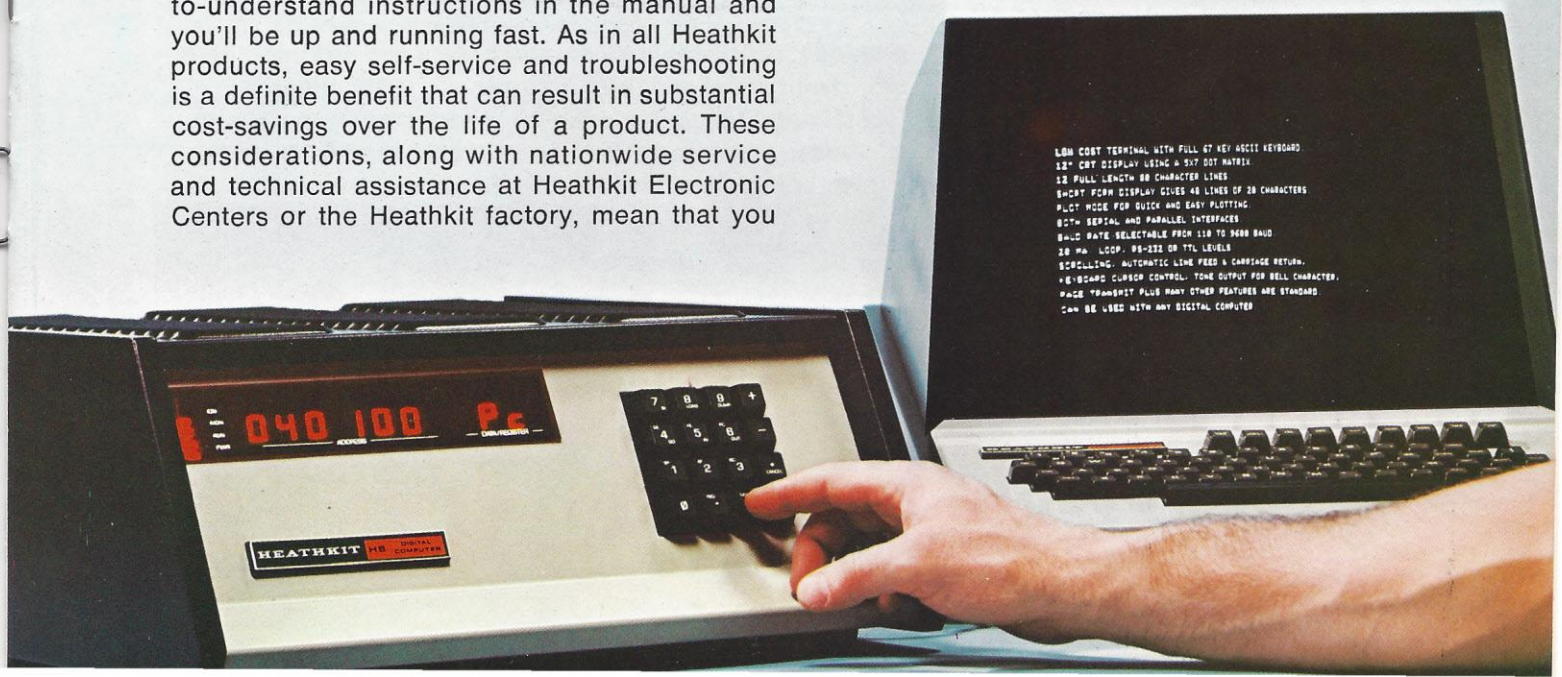

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The Heathkit H8 computer is an 8-bit machine based on the popular 8080A chip. It is one of the lowest-cost general-purpose computers on the market, and thanks to Heath's exclusive design, one of the most versatile.

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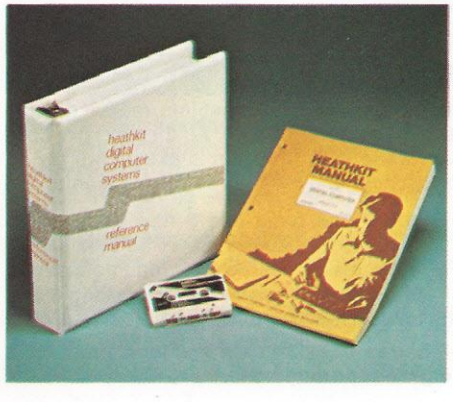
The octal keyboard and display emulate a true hardware front panel with complete access to memory, all registers and functions. The 9-digit seven-segment octal display has three readout modes: 6 digits of address and 3 digits data; 6 digits register data and 2 digits register identification; and three digits data with three digits port address. The front panel functions are defined by a panel monitor control program (PAM-8) stored in a 1K x 8 ROM on the CPU board. The complete access to 8080 internal circuits and functions makes the H8 an ideal trainer and learning tool.

Complete front panel functions include: display and alter of memory locations; display and alter of registers; dynamic monitoring of registers or memory during program execution; program execution control including break-point capability and single instruction step; automatic tape load and store through a built-in routine that allows programs to be loaded with a single button; and write or read any I/O port. The front panel of the H8 is so versatile it's like having a mini I/O terminal built right in!

Other features of the H8 front panel include status lights for power-on, run, monitor and interrupt enable; a built-in speaker for audible feedback on keyboard entry. The speaker also can be programmed for variable tones, permitting a variety of special effects to be generated.

The CPU board is fully wired and tested. It features the 8080A, clock, systems controller, ROM monitor and full bus buffering. Seven vectored interrupts are available on the bus for quick response to your I/O requests. A built-in clock lets you design and run in real time.

The H8 uses an exclusive, Heath-designed bus which incorporates many practical improvements over existing busses. The bus is fully buffered to reduce noise and crosstalk and is "glitch" free to eliminate timing problems. Three-state line drivers and receivers are used on all bus lines to eliminate loading problems. The 50 lines include address, data, control, clock and interrupt lines, plus all signals needed to support the 8080 MPU and virtually any I/O or memory accessory. The bus is implemented on a heavy-duty printed circuit mother board with wide, heavy copper foils for greater physical strength plus reduced crosstalk and noise. The board has 10 positions for installing connectors that accept the front panel, CPU, memory, I/O and accessory cards. All I/O bus connectors are included with the mother board for fast and easy expansion when you want it.



Comprehensive Heathkit assembly and operations manuals give you the superior documentation you NEED for a thorough understanding of your H8.

Systems software is supplied in audio cassette format.

The H8's built-in power supply is convection cooled for adequate ventilation without the use of noisy fans. Separate IC regulators provide distributed regulation with a heat sink on each circuit board for excellent heat dissipation. Power supplies of +8, −18 and +18 volts are provided to handle up to 32k memory plus three I/O interfaces. Switch-selectable 120 V, 60 Hz or 240 V, 50 Hz AC increases versatility.

The H8 includes all system software in 1200 baud audio cassette form at no extra charge. The Benton Harbor BASIC™ is an enhanced version of standard Dartmouth BASIC with unique statements and commands to extend usefulness. The efficient compression techniques of the Benton Harbor BASIC permit you to put more program in less space.

All H8 systems software is supplied in audio cassette form. Also available in paper tape (H8-15, page 5) at extra cost.

HASL-8 The Heathkit Assembly language is a 2-pass absolute assembler that lets you program with easily understood mnemonics and generates efficient machine language code. A minimum of 8K memory is required.

The TED-8 software is a line-oriented text editor used for generating source programs for the assembler or general word processing. Requires a minimum of 8K memory.

The BUG-8 a powerful terminal console debug program, is an enhanced and extended version of the front panel monitor program to allow entry and debugging of user machine language programs via an external terminal. Requires 3K memory plus user program.

The H8 is housed in a rugged, heavy-duty cabinet, 16¼″ W x 6½″ H x 17″ D. Requires at least one H8-1 Memory.

Kit H8, Shpg. wt. 30 lbs. **375.00**

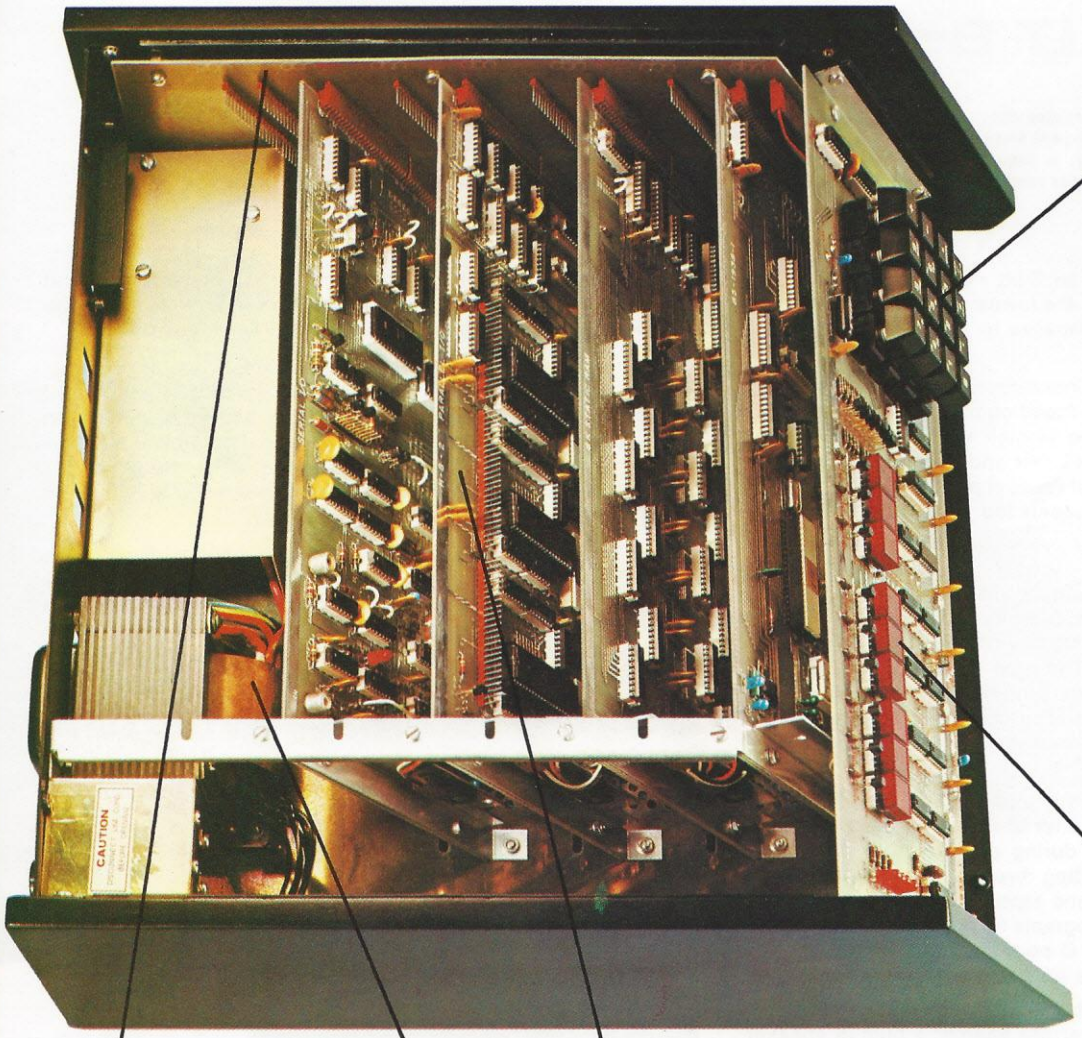
Suggested applications for the H8 computer: As a trainer—learn microprocessor operation, interfacing and programming. The powerful front panel lets you get at and use all parts of the unit.

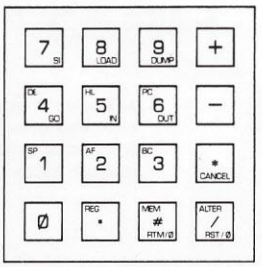
As an entertainment center—use game and other applications programs for entertainment the whole family can enjoy.

As a hobby computer—the H8 can be used to process any information you program into it—it's perfect for hobby experimentation and design. A variety of peripherals and interfaces let you use it with other equipment—run your Ham radio station, control your model railroad systems, etc.

As an educational system—the H8 is ideal for schools, community colleges, libraries, etc. Full H8 software permits teaching BASIC plus machine and assembly language programming.

As a home management center—use the H8 to keep telephone numbers, monitor your budget, keep your checkbook balanced, do your income taxes, inventory your personal belongings. There are hundreds of ways the H8 can make your life more convenient.





Its unique front panel keyboard makes the H8 the most powerful and sophisticated low-cost general-purpose computer available. Just take a look at these features!

- Direct-access to registers and memory even while program is running
- One button load and dump for fast, uncomplicated system startup
- Single instruction key lets you "step" through programs for easy debugging, program evaluation and learning
- Input/output keys let you communicate directly with any port

The unique Heath-designed 50-pin bus is implemented on a heavy-duty printed circuit board with heavy copper-foil bus lines. The 10-position mother board is complete with all connectors. The bus lines are fully buffered to eliminate noise and crosstalk, and "glitch-free" to prevent timing problems.

Modular circuit boards slide into the H8 mainframe for easy memory and I/O expansion, easy access for servicing. The boards are in a semi-vertical position with unconfined heat sinks to enhance convection cooling and improve heat dissipation.

Heavy-duty power supply, rugged steel chassis and securely mounted and braced circuit boards make the H8 a truly reliable and long-life machine.

Memory Display

High Order Address Location | Low Order Address Location | Data at Location 040 100

Register Display

High Order Contents | Low Order Contents | Register Identification

I/O Port Display

Data | Port Number

Unique Heathkit Software.

The Heathkit software supplied with the H8 computer has a number of features that make it easier to use and more practical than conventional systems. Automatic "command completion" simplifies typing; dynamic syntax checking instantly alerts you to errors and a special user configuration lets you really personalize your system. H8 software pushes the state-of-the-art a generation ahead — it's memory efficient to give you more computing power for your memory dollar, modular design for easy expansion, and thoroughly documented for easy programming and maximum effectiveness.

H8 "Intelligent" Front Panel

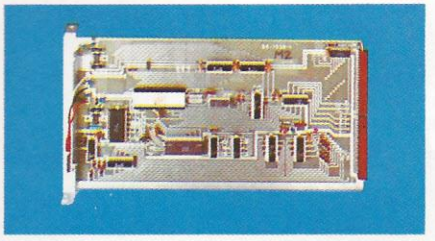
The H8 front panel digital readout is the most informative display available on any personal computer to date. All displays are continuously updated even while your program is executing, giving you instant access to registers and memory for direct monitoring of program activity.

MEMORY DISPLAY — Shows memory location and contents using 6 digits for address and 3 digits for data.

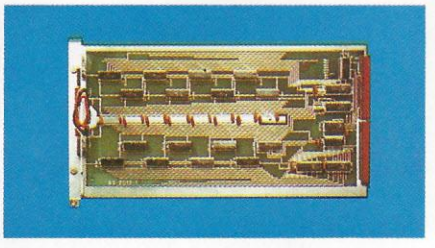
REGISTER DISPLAY — Shows CPU-register contents using 6 digits for data and 2 digits for register identification.

I/O PORT DISPLAY — Shows I/O port data and location using 3 digits for data and 3 digits for port address.

H8 ACCESSORIES, SOFTWARE AND MANUAL SET



The H8 CPU is fully wired and tested to insure quick and trouble-free system startup. It contains the performance proven 8080A microprocessor chip, a 1Kx8 ROM with monitor program for controlling the front panel and input-output (load-dump) routines. Other features of the CPU include: 7 vectored interrupts, DMA capability, crystal-controlled clock and fully buffered bus with three state drivers. Use of the 8080A, which has the largest software library of any microprocessor, along with Heath software and documentation, makes the H8 one of the most practical and immediately useful computers you can own.

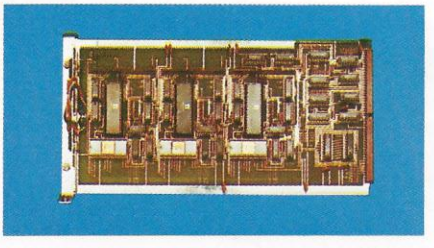


H8-1 Memory Board. 8Kx8 memory card supplied with 4K memory, plugs directly into H8 bus. Features maximum storage capacity of 8192 8-bit words. Uses modern 4Kx1 static memory IC chips for easy assembly and service. Access time, less than 450 nS. With on-board regulators, heat sinks and full buffering. Expandable to 8K memory with H8-3 chip set below.

Kit H8-1, Shpg. wt. 2 lbs. **140.00**

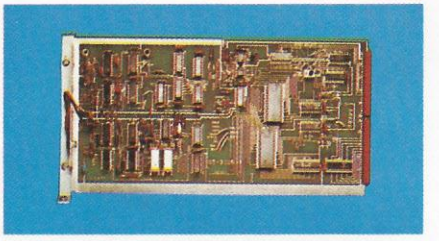
H8-3 Chip Set. Kit of eight 4K static memory IC's. Expands H8-1 to full 8K storage. With sockets.

Kit H8-3, Shpg. wt. 1 lb. **95.00**



H8-2 Parallel Interface. Connects H8 to any parallel device such as a paper tape reader/punch (required for H10) or line printer. Has three independent parallel ports, each with 8 bits input and 8 bits output and universal handshaking capability. Compatible with all Heath software. 390 μS maximum transfer time. With diode-clamped inputs, buffered outputs and full interrupt capability.

Kit H8-2, Shpg. wt. 3 lbs. **150.00**



H8-5 Serial I/O and Cassette Interface. Connects the H8 to serial devices such as the H9 video terminal (page 10) or the H36 DEC Writer II (page 12). Features jumper selectable data rate from 110 to 9600 baud, plus common input/output interfaces including 20 mA current loop and EIA RS-232C compatible levels. The cassette recorder interface permits the use of standard cassette recorders (Heathkit ECP-3801, page 12). Uses the popular Byte/Manchester or "Kansas City" standard recording format with a 300 or 1200 baud read/record rate. Control lines for remote start and stop of two cassette units allow separate record and playback for easy program or file editing. Also has full interrupt capability. LED test circuit for easy board setup and overall system servicing. Fully compatible with all Heath software.

Kit H8-5, Shpg. wt. 3 lbs. **110.00**

NOTE: Proper operation of the H8-5 is assured only if you use the Heath ECP-3801 cassette player/recorder and Heath-recommended recording tape (ECP-3802, page 12). Heath is not responsible for improper operation associated with other cassette units.

Extended Benton Harbor BASIC

Extended Benton Harbor BASIC is an enhanced and more powerful version of the BASIC supplied with the H8. It provides even faster operation and includes character strings, additional convenience commands and math functions, dynamic storage allocation, access to real time clock, keyboard interrupt processing, expanded error messages and recovery ability, LED display control and key pad support. A minimum of 12K memory is required to run this BASIC, 16K is preferred if full use is to be made of its capabilities.

H8-13 (1200 baud audio cassette)
Shpg. wt. 1 lb. **10.00**

H8-14 (fan fold paper tape)
Shpg. wt. 1 lb. **10.00**

Paper Tape Systems Software

A paper tape version of the systems software supplied with the H8 computer. It consists of four fan fold paper tapes, one each for Benton Harbor BASIC, HASL-8 assembler, TED-8 editor, and BUG-8 debug. For use with the H10 paper tape reader/punch or other paper tape I/O equipment.

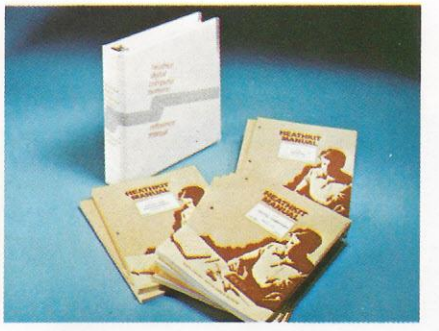
H8-15, Shpg. wt. 1 lb. **20.00**

H8 Manual Set

Find out about the H8 before you buy! This manual set includes the complete assembly and operations manuals for the H8 Digital Computer, H8-1 memory card, H8-2 parallel interface, H8-3 4K memory expansion chip set, H8-5 serial and I/O cassette interface, H9 video terminal and H10 paper tape reader/punch. H8 software documentation covering monitor, editor, assembler, debug and BASIC is also included. In handsome 3-ring binder.

HM-800 Manual Set.
Shpg. wt. 11 lbs. **25.00**

The purchase price of the HM-800 manual set will be refunded when you buy the H8. Simply include HM-800 saleslip with your order.



Heath User's Group

You can get even more excitement and practical use from your H8 by joining HUG, the Heathkit User's Group. It will put you in contact with other Heathkit computer users, provide a program library and an informative newsletter to keep you up to date. A HUG application is enclosed with each Heathkit computer product. See page 12 for further details.

THE HEATHKIT H11 DIGITAL COMPUTER

Two of the finest names in modern electronics, Heath and Digital Equipment Corporation (DEC) combine to bring you the world's first 16-bit computer priced within reach of the general public!

$1295.00

charg-a-kit

The H11 and all its accessories will be available November 10th, 1977.

HEATHKIT®/DIGITAL EQUIPMENT CORPORATION®
H11 DIGITAL COMPUTER

Heath and DEC join forces to bring you mini-computer performance at a microcomputer price! The H11 features a fully wired and tested DEC KD11F board that contains the 16-bit LSI-11 CPU, 4096 x 16 read/write MOS semiconductor memory, DMA operation; and includes the powerful PDP-11/40 instruction set, PLUS Heath/DEC PDP-11 software. Equivalent commercial versions of the H11 would cost $1,000's of dollars more!

The new Heath/DEC H11 personal computer is one of the most powerful and sophisticated units available today! It combines the advanced, performance-proven hardware and software of the LSI-11 with Heath's expertise in kit design and documentation to bring you a personal computer of almost incredible power and flexibility. Equivalent commercial versions of the H11 would cost over twice as much, and you still wouldn't get the superior documentation and support of the H11!

The LSI-11 bus is a mechanically and electrically superior bus with 38 high-speed lines containing data, address, control and synchronization lines. Sixteen lines are used for time multiplexing of data and addresses. All data and control lines are bidirectional, asynchronous, open-collector lines capable of providing a maximum parallel data transfer rate of 833K words per second under direct memory access operation.

The 16-bit CPU functions are contained on four MOS LSI integrated circuit chips. These chips provide all instructions, decoding, bus control, and ALU functions of the processor. The CPU has eight general registers which serve as accumulators, index, autoincrement/autodecrement registers or stack pointer.

The KD11F memory is a 4096-by-16 MOS semiconductor memory composed of LSI 4K dynamic RAM chips. These chips require little power, provide fast access time, and are refreshed automatically by the processor's microcode. Additional memory cards can be added to expand memory capacity up to 20K in the H11 cabinet (32K words total).

The backplane/card guide assembly holds the microcomputer and up to six I/O and memory modules. All LSI-11 bus data, control, and power connections are routed on the printed circuit backplane to each module location. The backplane/card guides are fully compatible with all standard DEC LSI-11 accessories.

An efficient, well-designed switching power supply provides the required DC voltage for the LSI-11 as well as all accessory modules. The supply features overvoltage and overcurrent/short-circuit protection, power fail/automatic restart and a built-in fan for quiet cooling. The dual primary power configuration can be connected for 115 V, 60 Hz or 230 V, 50 Hz input power.

Has single-level, vectored, automatic priority interrupt, real-time clock input signal line, ODT/ASCII console routine/bootstrap resident in microcode for automatic entry into debugging mode, replacement of panel lights and switches with any terminal device generating standard ASCII code, and the ability to automatically commence operation through resident bootstrap routines.

The H11 is supplied with versatile PDP-11 software including editor, relocatable assembler, linker, absolute loader, debug program, I/O executive program, dump routines, BASIC and FOCAL (See details below). The software requires a minimum of 8K memory, with 12K to 16K total memory recommended for maximum capability. Rugged metal cabinet measures 6½" H x 19" W x 17" D. For 110/220 VAC, 50/60 Hz.

Kit H11, Shpg. wt. 34 lbs. **1295.00**
NOTE: See DEC software license form on page 15.

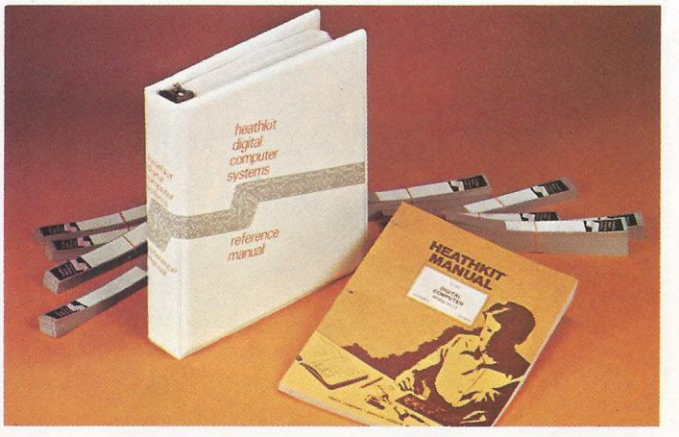
POWERFUL HEATH/DEC PDP-11 SOFTWARE AT NO EXTRA COST!

The H11 includes a sophisticated software system that lets you get your computer up and running with practical programming capabilities. This paper tape based software would cost over $1200 if purchased separately. A minimum of 8K memory is required to run the software. The programs include:

ED-11. Assists you in the creation and modification of ASCII source tapes, also used to write assembly language programs and for general text editing or word processing functions.

PAL-11S. Relocatable assembler converts ASCII source tapes into relocatable binary modules. This lets you create programs in small, modular segments for easier coding and debugging. These binary modules serve as inputs to LINK-11S.

LINK-11S. Link editor which links the modules created by the PAL-11S into a load module ready for execution on the H-11. The module is loaded into the H-11 via the Absolute Loader.



The H11 is complete with superior Heathkit documentation and versatile system software.

Absolute Loader. Loads absolute binary tapes into the H11 memory for execution.

ODT-11X. Lets you debug the programs which you have created. Permits modifying and controlling program execution "on the fly" for quick, efficient debugging.

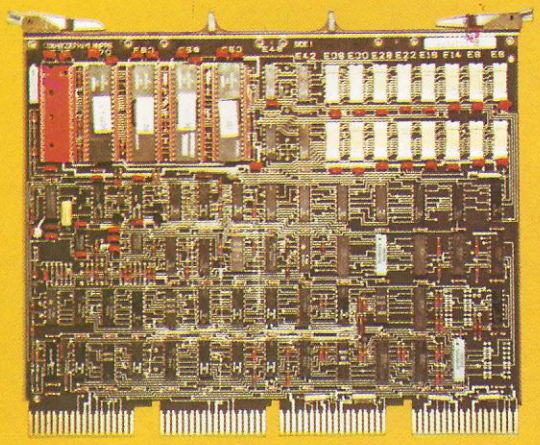
IOX. I/O executive program permits I/O programming without developing device-driving programs. Links to your programs using the LINK-11S. For use with high speed paper tape reader/punch and line printer.

DUMP-AB and DUMP-R. Lets you dump absolute binary contents of memory into the paper tape punch.

BASIC. DEC's powerful version of standard Dartmouth BASIC interpreter uses english-type statements and mathematical symbols to perform operations. Immediately translates, stores and executes the program. Includes string capability.

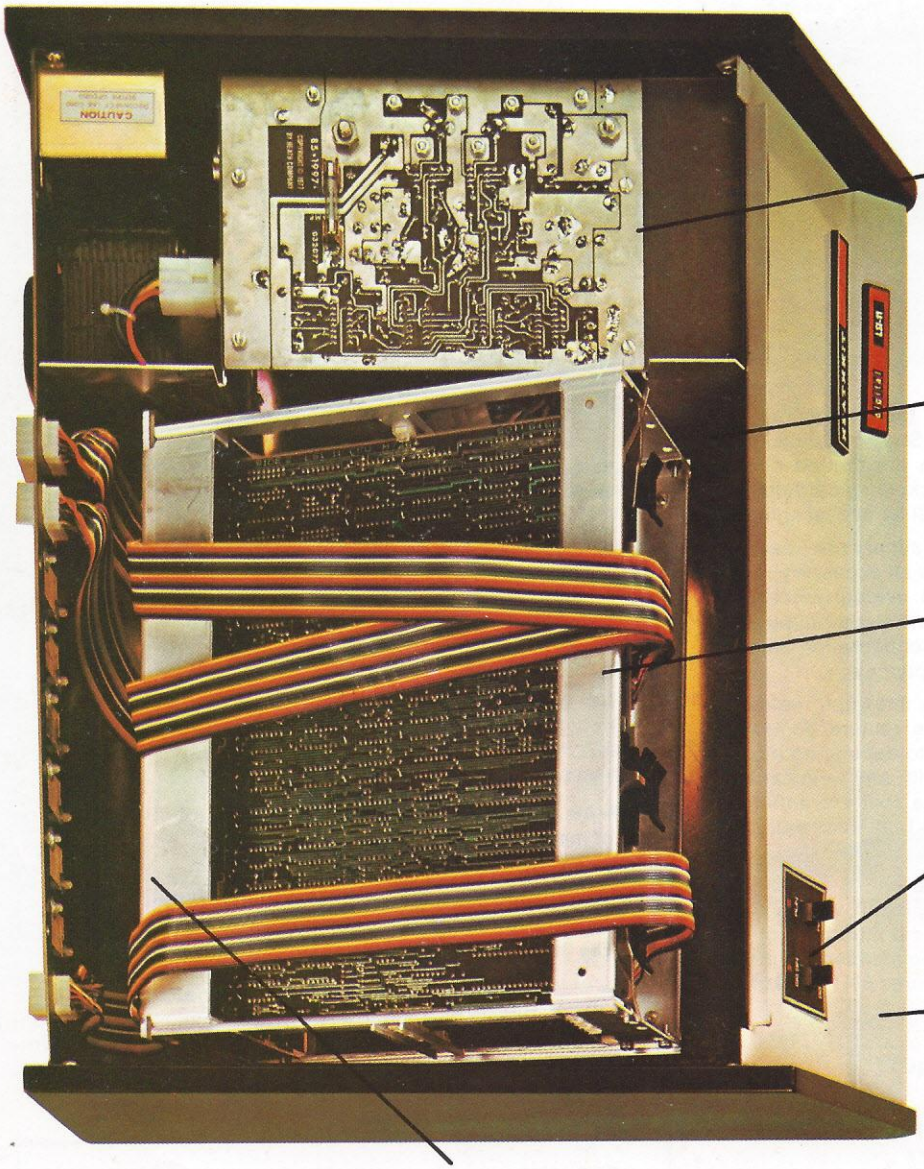
FOCAL™. DEC's own interpretive computer language which combines simplicity with computing power. Ideal for most scientific, engineering and math applications. FOCAL™ programs can be written and executed easily. Both 4K and 8K versions are included.

NOTE: H11 owners are eligible for membership in the Digital Equipment Computer User's Society (DECUS). This organization provides useful symposia, newsletters, program library and other useful information to help you get the most from your LSI-11 computer.



FULLY WIRED AND TESTED KD11F BOARD

The "heart" of the H11 computer is the standard DEC LSI-11 microcomputer board. The 16-bit CPU functions are contained in four silicon gate N-channel MOS LSI integrated circuit chips for high reliability and superior performance. The 4096-by-16 read/write MOS semiconductor memory is composed of LSI 4K dynamic RAM chips that provide fast access time and require little operating power. The CPU executes the powerful PDP-11/40 instruction set with over 400 instructions. There are no separate memory I/O or accumulator instructions, so you can manipulate data in peripheral device registers as easily and flexibly as in memory registers. The LSI-11 board is supplied fully wired and tested to facilitate kit assembly and provide greater reliability and less chance of error.



Compact, efficient switching power supply uses less power to operate and generates less heat than conventional supplies. Overvoltage and overcurrent/short circuit protection, along with automatic power-up and power-down sequencing, provide high reliability and long life operation.

Built-in quiet-running fan provides efficient cooling and prevents heat buildup.

Card cage with backplane accommodates up to six accessory cards in addition to LSI-11. The card cage swings up for easy access and service even while the H11 is operating. Accessory boards slide directly into card guides with all connectors supplied.

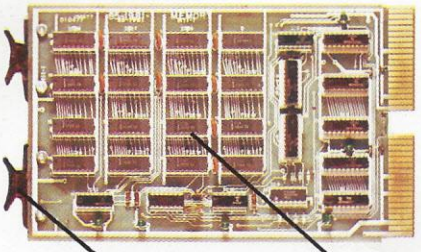
Front panel controls include DC power switch and run/halt switch. Status lights indicate processor activity.

Styled and sized to match Heathkit peripherals for total system continuity.

Rugged steel chassis and extra-thick backplane with heavy, solid connectors for added strength and years of superior performance.

The H11 and all its accessories will be available November 10th, 1977.

H11 ACCESSORIES, SOFTWARE AND MANUAL SET

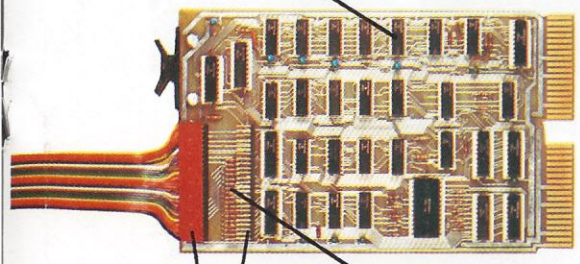


Card handles provide easy removal and insertion in card cage

Sixteen state-of-the-art 4K static memory chips for high density storage

1

All IC's are socketed for easy kit assembly, easy access for service or trouble-shooting

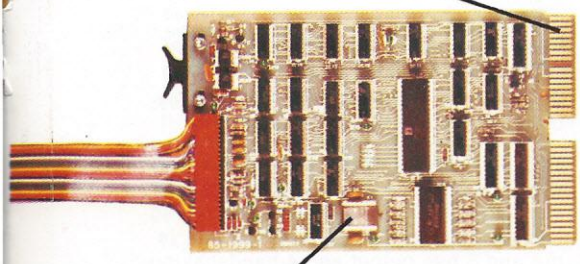


2

All inputs are diode-clamped for worry-free interfacing and system protection

Separate cables and rear panel connectors for high-byte and low-byte increase system flexibility

Gold-plated edge connectors maintain superior electrical contact for high reliability and long life



3

Quartz crystal and integrated baud rate generator has superior accuracy for reliable system interfacing

1 H11-1 4K Memory Expansion Module

Plugs into H11 backplane, adds 4K x 16-bit word capacity to H11 memory. Uses high-reliability 1Kx4 static MOS RAM chips. Access time is less than 500 nS. Has decode circuitry for operation on 4K address boundaries. Handle for easy removal and insertion. Compatible with PDP 11/03 and other LSI-11 backplane machines.

Kit H11-1, Shpg. wt. 2 lbs. **275.00**

2 H11-2 Parallel Interface

General-purpose parallel interface featuring 16 diode-clamped latched data input lines, 16 latched output lines, 16-bit word or 8-bit byte data transfers. Has LSI-11 bus interface and control logic for interrupt processing and vectored addressing; control status registers compatible with PDP-11 software routines. Four control lines for output data ready, output data accepted, input data ready and input data accepted logic operations. Maximum data transfer rate, 90K words per second under program control. Maximum drive capability, 25-ft. cable. Plugs into H11 backplane, can be used with DEC PDP-11/03 and other LSI-11 backplane machines. Also compatible with TTL or DTL logic devices. The H11-2 is required for interfacing the H11 to the H10 Paper Tape Reader/Punch.

Kit H11-2, Shpg. wt. 2 lbs. **95.00**

3 H11-5 Serial Interface

Universal asynchronous receiver/transmitter serial interface module for use between LSI-11 bus and serial devices such as the Heathkit H9 video terminal (page 10) or LA36 teleprinter (page 12). Has optically isolated 20 mA current loop and EIA interfaces; selectable baud rates of 50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2400, 4800 and 9600. Plugs into H11 backplane, fully compatible with PDP 11/03 and other LSI-11 backplane machines. With all mating connectors.

Kit H11-5, Shpg. wt. 2 lbs. **95.00**

H11-6 Extended Arithmetic Chip

Adds powerful arithmetic instructions to the LSI-11, including fixed point multiply, divide and extended shifts plus full floating point add, subtract, multiply and divide. Helps minimize or eliminate arithmetic sub-routines, speeds up program execution and eases program development. Saves memory space too. 40-pin dual-inline package IC plugs into socket on KD11F board.

H11-6, Shpg. wt. 1 lb. **159.00**

Manual Set for H11 Computer

Includes complete assembly and operation manuals for the H11 Digital Computer, H11-1 4K memory board, H11-2 parallel interface, H11-5 serial interface, H9 CRT terminal, and H10 paper tape reader/punch. Also includes complete software documentation — monitor, editor, assembler, linker, BASIC, FOCAL and related software. In handsome 3-ring binder.

HM-1100 Manual Set,
Shpg. wt. 12 lbs. **25.00**

NOTE: The price of the manual set can be deducted when you order an H11.

Special DEC Software License Requirement

H11 purchasers are required to fill out and sign the DEC license agreement on page 15. Please do so and include with your H11 order. Heath cannot ship merchandise without this license agreement.

THE HEATHKIT H9 VIDEO TERMINAL

One of the lowest-cost full ASCII terminals available anywhere — features a bright 12" CRT display with twelve 80-character lines, 67-key keyboard, all standard serial interfaces, plus a fully wired and tested control board and a wiring harness for simplified assembly.

$530.00

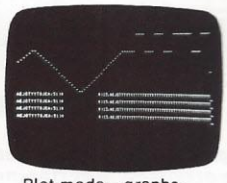
charg-a-kit

H9 LONG AND SHORT-FORM VIDEO DISPLAY TERMINAL

The H9 video terminal is a general-purpose computer peripheral designed for use with the Heathkit H8 or H11 computers. It provides keyboard input and a CRT for the convenient entry and display of computer programs and data. The H9 can be used with any digital computer in dedicated stand-alone applications or in time-sharing systems.

Long form — twelve 80-character lines

Short form — forty-eight 20-character lines



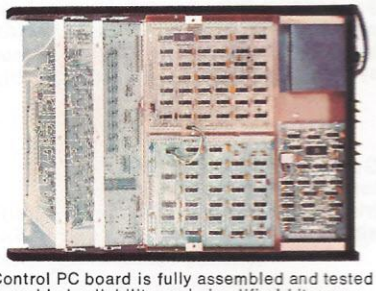
Plot mode — graphs, curves, simple figures

Three separate modes give the H9 real display versatility

Character format is standard upper case 5 x 7 dot matrix. The long form display is twelve 80-character lines. The short form display is forty-eight 20-character lines in four 12-line columns. The automatic line carryover feature executes line feed and return when line exceeds character count on both long and short form displays. A built-in oscillator/speaker generates a 4800 Hz tone and serves as audible end-of-line warning.

Auto-scrolling is featured in both long and short form. In the long form, as the line enters at bottom, the top line scrolls off-screen; in the short form, as new column enters from right, the left column scrolls off-screen. Auto-scrolling can be defeated with a front panel switch. The cursor mark indicates the next character to be typed for accurate positioning. Cursor control keys include up, down, left, right and home. Serial data baud rates are selectable from 110-9600. Baud rate clock output and reader control are available on the rear panel connector. The erase mode permits automatic full page erase or erase to end of line starting at cursor position. A transmit page function allows a full page to be formatted, edited and modified, then transmitted as a block of continuous data.

The plot mode permits graphs, curves and simple figures to be displayed. Plotting can be accomplished via the keyboard or from external inputs.



Control PC board is fully assembled and tested for added reliability and simplified kit assembly. A wiring harness with connectors helps reduce time-consuming point-to-point wiring.

The H9 serial interface provides EIA RS-232C levels, a 20 mA current loop or standard TTL levels. Parallel interfacing includes standard TTL levels, 8 bits input and 8 bits output and 4 handshaking lines.

Ultra-compact size, only 12½" H x 15⅝" W x 20¾" D, makes the H9 ideal for desktop or console applications. For 110 VAC, 60 Hz or 230 VAC, 50 Hz.

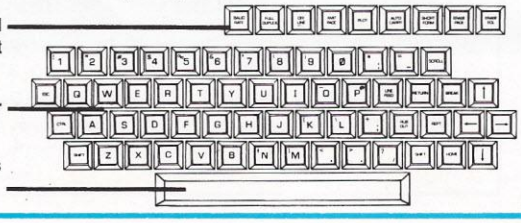
Kit H9, Shpg. wt. 50 lbs. **530.00**

Full ASCII 67-key Keyboard

Function keys are positioned away from characters to prevent miskeying and error.

Standard typewriter keyboard for easy, more accurate input.

Wide, easy-to-use space bar aids accurate typing.



THE HEATHKIT H10 PAPER TAPE READER/PUNCH

A general-purpose mass storage peripheral designed for use with the H8 and H11 computers plus any other computer. Features a heavy-duty built-in power supply, totally independent punch and reader and a copy mode for fast, easy tape duplication.

$350.00

H10 DELUXE PAPER TAPE READER/PUNCH

Heavy-duty solenoids for reliable, long-life operation

Precision machined punch block for accurate, consistent punched holes

Advanced reader design with stepper motor and solid-state sensors for accurate reading

The H10 is a complete paper tape reader/punch mass storage peripheral using reliable low-cost paper tape. It's fully compatible and styled to match with the H8 and H11 computers. It also works reliably with any other computer through a parallel interface. The H10 uses standard 1" wide roll or fan-fold 8-level paper tape. Standard punched paper tape gives you the reliability, durability and trouble-free handling you need for effective mass storage of programs and data.

The reader reads tape at a maximum rate of 50 characters per second. A full sensitivity adjustment on each channel permits any color, thickness, quality (oiled or unoiled) paper tape to be used. Sensitive photo Darlington transistors and an incandescent lamp reader head provide reliable reading. The powerful stepper motor drive insures accurate tape positioning and movement.

The punch operates at a maximum speed of 10 characters per second. Precise ratchet/solenoid drive and reliable solenoid control of punches provide high-accuracy punching. The precision die-block punch head gives you positive and consistent punching.

Controls include power on-off, read and punch start. A feed control feeds blank paper tape through the punch to produce leader tape. A copy control on the rear panel permits tape being read to be duplicated by the punch for efficient and accurate tape copying.

Interface has parallel 8-bit input bus for punch, parallel 8-bit output bus for reader, standard TTL logic levels and handshaking lines for both reader and punch. A rear panel 24-pin interface connector and mating cable are supplied. The H10 is fully compatible with Heathkit H8 and H11 computers when the appropriate parallel interface accessories are used. It can also be interfaced with other computers with parallel interface facility.

Accessories include holder for roll paper tape, chad collector tray, and collector box for fan-fold tape. With 8" roll (900 ft.) blank paper tape.

Styled to match the Heathkit H8 and H11 computers. Cabinet with metal top and rugged steel chassis, 12⅝" H x 9¾" W x 19⅝" D. For 110-130 VAC, 60 Hz, or 220-240 VAC, 50 Hz.

Kit H10, Shpg. wt. 29 lbs. **350.00**

H10-2, Three Blank Rolls Paper Tape, each 8" diameter, 900 ft. min.

H10-2, Shpg. wt. 5 lbs. **10.00**

H 10-3, Three Boxes Blank Fan-fold Tape. Approx. 1000 ft. each.

H10-3, Shpg. wt. 5 lbs. **10.00**

ECP-3801 Cassette Recorder Storage Device

Has volume and tone controls, pushbuttons for record, play, rewind, fast forward, stop and eject, built-in 3-digit counter with reset button. Factory wired, not a kit.

ECP-3801, Shpg. wt. 6 lbs. **55.00***

Heath recommended high output, low noise, premium grade audio recording tape. Pack of three 30-minute blank cassettes.

ECP-3802, Shpg. wt. 1 lb. . . . . **per pack 5.00**

*NOTE: Proper operation of the H8-5 and H8 software is assured only when the ECP-3801 cassette recorder and ECP-3802 tape is used. Heath does not assume responsibility for improper operation resulting from the use of any other cassette units.

HUG®–the Heathkit User's Group

Our new user's group brings you in contact with other Heathkit computer owners and users, provides a newsletter, a program library, new product information and hardware/software ideas. Membership in HUG is a useful, practical way to get the maximum enjoyment and benefit from your Heathkit computer system. Here's what you get:

- 1 year subscription to the quarterly newsletter
- Software library allowing you to submit programs and obtain programs submitted by others. A modest fee will be charged for software duplication.
- An attractive 3-ring binder to hold newsletters, software documentation and other materials.
- Program submission forms • Software library catalog
- HUG membership list • Credit toward purchase of software

Dues are $14.00 for one year. Complete details of HUG membership are included with every Heathkit computer product. H11 owners are also eligible for membership in DECUS, see page 7 for details.

LA36 DEC Writer II Keyboard Printer Terminal

The famous LA36 DEC Writer II with true 30-cps throughput, variable-width forms handling, 128-character upper/lower case set, and extra-quiet operation. Fully assembled, factory tested and ready to use!

The LA36 is an advanced technology teleprinter offering fast, reliable operation at one of the best price/performance ratios in the industry. It features a 7x7 dot matrix print head for crisp, clear character formation; switch-selectable 10, 15 and 30 cps printing speeds; variable width forms handling from 3 to 14⅞" wide; adjustable right and left hand tractors for precise margin positioning; half or full duplex operation; ANSI-standard multikey rollover and a typewriter-like keyboard.

The precision-designed stepper motor paper feed has fine vertical adjustment for accurate forms placement. LA36 will handle up to 6-part forms with a .020" maximum pack thickness. Print format is 132-column, with 10 characters per inch horizontal spacing and 6 lines per inch vertical spacing. Uses the entire 128 character ASCII upper/lower case set with 95 printable characters. A CAPS-lock key simplifies data entry. A parity check on output prints a replacement character, strappable to odd, even, or none with mark or space. A last-character visibility feature moves the head four columns to the right when printing stops, returns to proper position when printing is resumed.

The integral 20 mA current loop interface makes the LA36 compatible with both the H8 and H11 computers, as well as all other hobby and personal computers. Operates on 90-132 VAC or 180-264 VAC for reliable performance even under brown-out conditions. With connecting cable and integral stand for easy setup. Overall size, 27½" W x 33¼" H x 24" D.

H36 (LA36 DEC Writer II) Shipped Motor Freight, prepaid to your nearest terminal within the Continental U.S. Include your phone number on order for notification of arrival. Arrangements for home delivery at extra charge at your option. NO C.O.D ORDERS ACCEPTED. **$1495.00**

H36-1 Fan-fold paper for H36. Standard 14⅞" x 11" white and green, single part, lined paper. 3450 sheets per carton.

H36-1, Shpg. wt. 50 lbs. **30.00**

H36-2 EIA Interface. Provides EIA RS232-C or CCITT-V24 interface for LA36. Includes auto answer, timed disconnect and half/full duplex logic. Straps are available to send timed break (230 mS), 3000 mS long space, forced disconnect or do nothing (stops printing, discards data) on a paper-out condition. Modem controls and a 9-ft. cable with 25-pin data-set type connector are also supplied. Factory wired, not a kit.

H36-2. Shpg. wt. 1 lb. **65.00**

APPLICATIONS SOFTWARE–COMING SOON!

Both the H8 and H11 Digital Computers are supplied with complete systems software that provide you with everything you need to develop your own specific applications programs. However, you can make your computer immediately useful by using the programs below. These programs represent the beginning of a complete series of application software packages that will allow you to get immediate value from your computer system without a time consuming software development effort on your part. Described below are a series of game packages that make your computer an excellent source of entertainment and leisure time activities.

BLACKJACK. An interactive program game that allows four players to play the card game blackjack on the computer. The computer performs all of the functions of the dealer and keeps track of player progress, winnings and losses. The program is written in and runs under extended BASIC and requires a minimum of 16K of RAM in the H8 and 8K in the H11. Standard Las Vegas casino blackjack rules apply.

BIORHYTHM. This popular applications program computes standard biorhythm information and plots sinusoidal curves of your physical, emotional, and intellectual characteristics over a given time period. The biorhythm program will show you your ups and downs and will tell you your good and bad days. It will help you plan your activities. While this program is not a game, it is an entertaining activity that you and your friends and family will enjoy. The program runs under extended BASIC and requires 16K of RAM in the H8 and 12K RAM in the H11.

STARTREK. Startrek is perhaps the most popular computer game available. It allows you to guide, control and command the Starship Enterprise in its travels through the galaxy, fighting Klingons and solving a variety of problems. A truly challenging, sophisticated and entertaining computer game. Runs on the H8 or H11 computers with 8K of RAM or more.

GAME SET #1. This software package lets you play 8 popular computer games. These games include Craps, Orbit, Tic Tac Toe, Nim, Hexapawn, Hangman, Hmrabi, and Derby. 8K RAM or more is required on either the H8 or H11. These games will provide hours of entertainment for you and your family.

GAME SET #2. Another popular game package for the H8 and H11 computers. Contains 8 popular computer games including bagles, slot machine, gomoko, yahtze, apollo, gunner, wumpus, and cube.

AVAILABILITY. Blackjack, Biorhythm and Startrek will be available after October, 1977. Game Set #1 will be available November, 1977 and Game Set #2 available, February, 1978.

Order a complete Heathkit computer system and SAVE!

The ECP-3801 is the Heath-recommended cassette recorder/player for use with the H8 computer software. See opposite page for complete description.

SYSTEM ONE

The minimum recommended H8 system

H8 Computer	$375
H8-1 4K Memory	140
H8-3 4K Chip Set	95
H8-5 Serial I/O and Cassette Interface	110
H9 Video Terminal	530
ECP-3801 Cassette Recorder/Player	55

If purchased separately, $1305.00

Heath System price is $1239.75*

Choose any of the Heath-recommended systems shown here, the specially-priced HS-11 system below, or "roll your own" with a selection of products you choose. Any way you do it, you'll get a top-value, high-performance system, and you'll SAVE 5%!

Here's how to qualify for the 5% computer systems discount:

1. Select either the H8 or H11 and one major peripheral (H9, H10 or LA36).
2. Choose the I/O interface, memory and software accessories you need.
3. Specify each in the spaces provided on the order blank.
4. Deduct 5% from the total price of the products (excluding shipping and handling charges).

*Systems illustrated already have discount prices calculated for you.

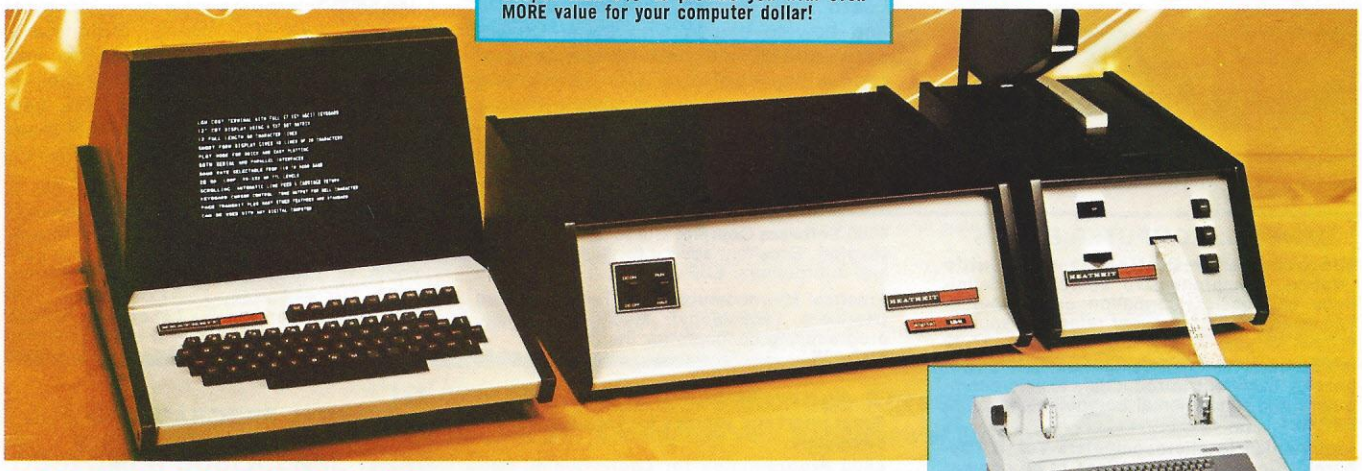
From time to time, Heath will offer specially priced total systems such as the HS-11 below. These systems will be discounted even deeper than 5% to provide you with even MORE value for your computer dollar!

SYSTEM TWO

H8 Computer	$375
Two H8-1 4K Memories	280
Two H8-3 4K Chip Sets	190
H8-5 Serial I/O and Cassette Interface	110
H8-13 Extended BASIC in Cassette Format	10
H9 Video Terminal	530
ECP-3801 Cassette Recorder/Player	55

If purchased separately, $1550.00

Heath System price is $1472.50*



SYSTEM THREE

The minimum recommended H11 system

H11 Computer	$1295
H11-1 4K Memory	275
H11-2 Parallel Interface	95
H11-5 Serial Interface	95
H9 Video Terminal	530
H10 Paper Tape Reader/Punch	350

If purchased separately, $2640.00

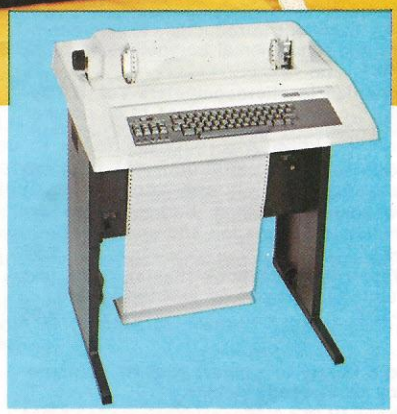
Heath System price is $2508.00*

SYSTEM FOUR

SAVE EVEN MORE on this specially-priced Heath HS-11 complete computer system!

H11 Computer	$1295
H11-1 4K Memory	275
H11-2 Parallel Interface	95
H11-5 Serial Interface	95
H10 Paper Tape Reader/Punch	350
H36 LA36 DEC Writer II	1495

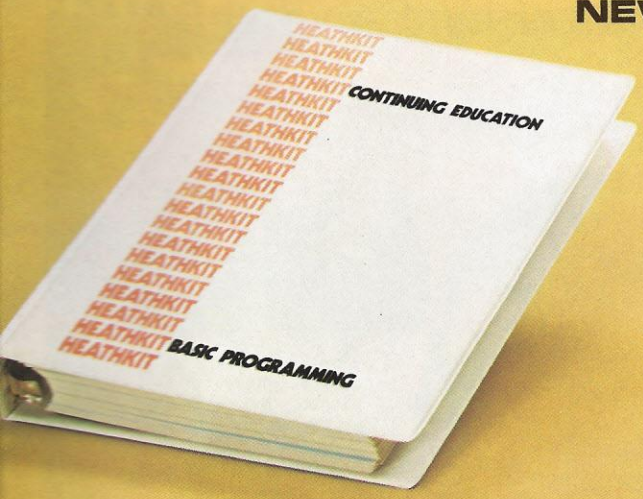
If purchased separately, **$3605.00**



$3350.00*

YOU SAVE $255!

NEW HEATHKIT SELF-INSTRUCTIONAL COMPUTER COURSES



These Heathkit self-instructional courses are designed to help you get the most from your computer investment, whether you buy your computer hardware from Heath or anywhere else. While many predeveloped software programs are available, the only way to realize the full value of your personal computer is to learn programming yourself. These courses use the PROVEN Heathkit individual learning techniques to give you a thorough understanding of programming, even if you have no prior knowledge or experience. They'll show you exactly how to make your personal computer system really personal!

BASIC PROGRAMMING SELF-INSTRUCTIONAL COURSE

This course teaches you how to program your computer using the popular BASIC language. BASIC (Beginner's All-Purpose Symbolic Instruction Code) is essential for hobby and personal computing; it is also widely used in education and business. The course covers all formats, commands, statements and procedures plus the creative aspects of computer programming, so you can make practical use of it in solving problems and creating your own unique programs. Like other Heathkit self-instructional courses, it uses programmed instructions backed by practical hands-on computer experiments and demonstrations to reinforce and personalize the text material. An optional final exam (passing grade 70%) brings you a Certificate of Achievement and 3.0 Continuing Education Units*. While the BASIC course is keyed to Heathkit computers, it is also equally applicable to any computer system using BASIC. Available after Oct. 20th, 1977.

EC-1100, Shpg. wt. 6 lbs. **29.95**

*Continuing Education Units (CEU's) are nationally recognized means of acknowledging participation in non-credit adult education.

COMING SOON!

8080 Programming: Teaches you the machine and assembly language used with 8080-based computers. Shows you how to use the editor, assembler and debug software to create efficient programs. Ideal for the H8 and other 8080A based machines. Coming soon.

LSI-11 Programming: Shows you how to use editor, assembler, linker, debug and executive I/O software to create efficient programs. Applicable to H11 and most other Digital Equipment Corporation PDP-11 series computers. Coming soon.

COMING IN OCTOBER!
MICROPROCESSOR SELF-INSTRUCTIONAL COURSE

Learn how microprocessors operate and how to design with them. Covers applications, machine language programming, hardware I/O interfacing and much more. The course includes all IC's needed to perform exciting experiments. The microprocessor trainer used with the course features the popular 6800 microprocessor plus 256 bytes of RAM, a 1K ROM monitor, 6-digit hexadecimal display and hexadecimal keyboard. The Heathkit microprocessor course/trainer combo is the fast, easy low-cost way to learn about these important devices. Watch for it in our next catalog!

GENERAL COMPUTER BOOKS

Microcomputer Dictionary and Guide (Matrix). Comprehensive source of definitions and basic information on computers and related topics. A super reference source. A must for your library. **EDP-218** **17.95**

Introduction to Microcomputers Vol. I (Osborne). Excellent introduction to microcomputers and fundamental computer concepts. **EDP-224** **7.50**

Introduction to Microcomputers Vol. II (Osborne). Complete descriptions of all popular microprocessors, 8080, 6800, 6502, SC/MP, Z80, F8, 2650, etc. Good reference. **EDP-225** **12.50**

How to Buy and Use Minicomputers and Microcomputers (Sams). A fundamental text on mini/micro operation and application. **EDP-227** **9.95**

TV Typewriter Cookbook (Sams). Good text explaining I/O terminals, interfacing, etc. **EDP-226** **9.95**

8080 BOOKS

Build a library to support your H8 computer or any 8080 based machine.

Bugbook III (E & L). Superior reference source on 8080 interfacing and programming. Includes experiments. **EDP-231** **15.00**

Bugbook IIA (E & L). Serial I/O concepts and terminal interfacing. **EDP-232** **5.00**

8080 Programming for Logic Design (Osborne). Programming and Using the 8080 microprocessor. **EDP-229** **7.50**

8080 Software Gourmet Guide and Cookbook (Scelbi). Excellent source for 8080 programs and subroutines. **EDP-228** **9.95**

Practical Microcomputer Programming: 8080 (Northern Technology). Machine/Assembly programming concepts for the 8080. **EDP-235** **21.95**

6800 BOOKS

Great reference sources for your 6800 based computers.

6800 Programming for Logic Design (Osborne). Programming and using the 6800 microprocessor. **EDP-230** **7.50**

6800 Software Gourmet Guide and Cookbook (Scelbi). Excellent source of commonly used 6800 programs. **EDP-233** **9.95**

6800 Microprocessor Applications Manual (Motorola). Comprehensive review of typical 6800 applications, design solutions, etc. **EDP-244** **25.00**

6800 Microprocessor Programming Manual (Motorola). Programming principles and examples for the 6800. **EDP-245** **10.00**

H11/LSI-11/PDP-11 BOOKS

Here are several important reference sources to help you get the most value from your H11 Computer.

Minicomputer Systems: Organization and Programming (Prentice-Hall). Good basic text. Emphasis on the PDP-11. **EDP-238** **17.95**

PDP-11 Programming (Algonquin). A programmed instruction text teaching the concepts of PDP-11 operation and programming. **EDP-239** **5.00**

The Minicomputer in the Laboratory (Wiley). Operation, programming and applications of PDP-11 computers. **EDP-246** **19.50**

GENERAL PROGRAMMING AND APPLICATIONS BOOKS

Assembly Level Programming (Lexington). Good basic book on assembly language programming of small computers. **EDP-236** **14.95**

101 BASIC Computer Games (DEC). A classic. Have fun with your computer. **EDP-237** .. **7.50**

BASIC Software Library, Vol. I. Complete lists of BASIC applications programs bookkeeping, games, pictures (graphics). **EDP-240** **24.95**

BASIC Software Library, Vol. II. Math, engineering, plotting and statistical programs in BASIC. **EDP-241** **24.95**

BASIC Software Library, Vol. III. Advanced business applications programs in BASIC. **EDP-242** **39.95**

BASIC Software Library, Vol. IV. Games and business applications programs in BASIC. **EDP-243** **9.95**

BASIC Software Library, Vol. V. Games, graphics, and useful math programs in BASIC. **EDP-251** **9.95**

HEATH
Schlumberger

Heath Company, Dept. 352-330
Benton Harbor, Michigan 49022

ORDER FORM
Agreement

To remove order form cut out entire page along dotted line.

Gentlemen: Please send me the Heathkit Computer Products I have checked below. I understand that if I order products designated for future delivery Heath will do their best to ship within 30 days of those availability dates.

- ☐ H8 Computer at $375.00 each plus $5.40 shipping and handling.
- ☐ Qty. _____ H8-1 4K Memory(s) at $140.00 each plus $1.15 shipping and handling.
- ☐ Qty. _____ H8-3 4K Chip Set(s) at $95.00 each plus $1.15 shipping and handling.
- ☐ H8-2 Parallel Interface at $150.00 each plus $1.30 shipping and handling.
- ☐ H8-5 Serial I/O Cassette Interface at $110.00 plus $1.15 shipping and handling.
- ☐ H8-13 Extended BASIC Cassette at $10.00 each plus $1.15 shipping and handling.
- ☐ H8-14 Extended BASIC on paper tape at $10.00 each plus $1.15 shipping and handling.
- ☐ H8-15 Paper Tape Systems Software for H8 at $20.00 each plus $1.15 shipping and handling.
- ☐ HM-800 Manual Set at $25.00 each plus $2.37 shipping and handling.
- ☐ H11 Computer at $1295.00 each plus $5.52 shipping and handling.
- ☐ Qty. _____ H11-1 4K Memory(s) at $275.00 each plus $1.15 shipping and handling.
- ☐ H11-2 Parallel Interface at $95.00 each plus $1.15 shipping and handling.
- ☐ H11-5 Serial Interface at $95.00 each plus $1.15 shipping and handling.
- ☐ Please send the following Computer Books (order must total $10.00 minimum) postpaid (Print numbers plainly.)

  _____

  _____
- ☐ H11-6 Extended Arithmetic Chip at $159 each plus $1.15 shipping and handling.
- ☐ HM-1100 Manual Set at $25.00 each plus $2.50 shipping and handling.
- ☐ H9 Video Terminal at $530 each plus $7.64 shipping and handling.
- ☐ H10 Paper Tape Reader/Punch at $350 each plus $4.96 shipping and handling.
- ☐ H10-2 Three Rolls Paper Tape at $10.00 plus $1.15 shipping and handling.
- ☐ H10-3 Three boxes Fan-fold Paper Tape at $10.00 plus $1.15 shipping and handling.
- ☐ H36 DEC Writer II at $1495 (No COD's, see page 12 for shipping information.)
- ☐ H36-1 Fan-fold Paper at $30.00 plus $7.76 shipping and handling.
- ☐ H36-2 E1A Interface at $65.00 each plus $1.15 shipping and handling.
- ☐ ECP-3801 Cassette Recorder/Player at $55.00 each plus $1.69 shipping and handling.
- ☐ ECP-3802 Cassette Recording Tape. Pkg. of three at $5.00 plus $1.15 shipping and handling per pkg.
- ☐ EC-1100 BASIC Programming Course at $29.95 plus $1.69 shipping and handling. Available after October.
- ☐ HS-11 Special Priced Complete System at $3350 each plus $14.00 shipping and handling.

Note: The H11 and all its accessories will be available November 10th, 1977.

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This form MUST accompany your H11 computer order.

CUSTOMER SUBLICENSE GRANT

HEATH COMPANY (hereinafter referred to as HEATH) pursuant to a license agreement with Digital Equipment Corporation (hereinafter referred to as DIGITAL) does hereby grant to CUSTOMER a non-transferable and non-exclusive sublicense to use the Binary Software Program(s) PTSP-11 Paper Tape System, FOCAL/PTS Language Processor, BASIC/PTS Language Processor (hereinafter singularly and/or collectively referred to as "Software") on the following terms and conditions.

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HEATH COMPANY

By William E. Johnson

CUSTOMER

By_____
Customer's Signature

Heathkit is the name to look for in quality electronic kits

Heath Company, located on the shores of Lake Michigan near Benton Harbor, is the world's largest manufacturer of electronic kits. Heathkit products are marketed primarily through the Heathkit Mail Order Catalog, published 5 times a year, and a nationwide chain of Heathkit Electronic Centers (Units of Schlumberger Products Corporation).

In addition to this new line of personal computing products, Heath Company offers nearly 400 other electronic kits of virtually every description. Product categories include Amateur Radio, Automotive Accessories, Stereo Hi-fi Components, Test Instruments, Color TV, Boating and Marine Accessories, Leisure and Home Improvement Products, and our award-winning self-instruction programs. Every Heathkit product is supplied with a comprehensive step-by-step instruction manual that tells you all you need to know, from unpacking the kit to plugging it in. These manuals are world-famous for their clarity, accuracy and precision. Let Heath show you how easily you can put together superior quality electronic products. Send for your FREE copy of our latest catalog!

Heathkit Computer Systems are also sold and serviced through 47 Heathkit Electronic Centers nationally (Units of Schlumberger Products Corporation) at slightly higher prices. Check the white pages of your telephone directory for the Heathkit Electronic Center nearest you.

Canadian Customers: Contact the Heathkit Electronic Center in most major cities or write for Canadian Prices to:

Heath Company, A Division of Schlumberger Canada, Ltd.
1480 Dundas Street E.
Mississauga, Ontario L4X 2R7

Printed in U.S.A.

The Zilog Z80 Instruction Set

Digital Design Magazine recently published this summary of the Z80 instruction set that will be of interest to Personal Computing readers. Of special interest is the graphic contrast with 8080 instructions. Though opcode mnemonics are different, the shaded portions represent the 8080 instruction set, which forms a subset of the Z80's.

	A	B	C	D	E	H	L	(HL)	Imm	(IX+d)	(IY+d)	
ADD	87	80	81	82	83	84	85	86	C6	DD86	FD86	add register to A
ADC	8F	88	89	8A	8B	8C	8D	8E	CE	DD8E	FD8E	add register to A with carry
AND	A7	A0	A1	A2	A3	A4	A5	A6	E6	DDA6	FDA6	and register with A
BIT 0	CB47	CB40	CB41	CB42	CB43	CB44	CB45	CB46	–	DDCB.46	FDCB.46	test bit 0
BIT 1	CB4F	CB48	CB49	CB4A	CB4B	CB4C	CB4D	CB4E	–	DDCB.4E	FDCB.4E	test bit 1
BIT 2	CB57	CB50	CB51	CB52	CB53	CB54	CB55	CB56	–	DDCB.56	FDCB.56	test bit 2
BIT 3	CB5F	CB58	CB59	CB5A	CB5B	CB5C	CB5D	CB5E	–	DDCB.5E	FDCB.5E	test bit 3
BIT 4	CB67	CB60	CB61	CB62	CB63	CB64	CB65	CB66	–	DDCB.66	FDCB.66	test bit 4
BIT 5	CB6F	CB68	CB69	CB6A	CB6B	CB6C	CB6D	CB6E	–	DDCB.6E	FDCB.6E	test bit 5
BIT 6	CB77	CB70	CB71	CB72	CB73	CB74	CB75	CB76	–	DDCB.76	FDCB.76	test bit 6
BIT 7	CB7F	CB78	CB79	CB7A	CB7B	CB7C	CB7D	CB7E	–	DDCB.7E	FDCB.7E	test bit 7
CP	BF	B8	B9	BA	BB	BC	BC	BE	FE	DDBE	FDBE	compare register with A
DEC	3D	05	0D	15	1D	25	2D	35	–	DD35	FD35	decrement register
INC	3C	04	0C	14	1C	24	2C	34	–	DD34	FD34	increment register
IN (C)	ED78	ED40	ED48	ED50	ED58	ED60	ED68	–	–	–	–	input to register
LD A	7F	78	79	7A	7B	7C	7D	7E	3E	DD7E	FD7E	load A with register
LD B	47	40	41	42	43	44	45	46	06	DD46	FD46	load B with register
LD C	4F	48	49	4A	4B	4C	4D	4E	0E	DD4E	FD4E	load C with register
LD D	57	50	51	52	53	54	55	56	16	DD56	FD56	load D with register
LD E	5F	58	59	5A	5B	5C	5D	5E	1E	DD5E	FD5E	load E with register
LD H	67	60	61	62	63	64	65	66	26	DD66	FD66	load H with register
LD L	6F	68	69	6A	6B	6C	6D	6E	2E	DD6E	FD6E	load L with register
LD (HL)	77	70	71	72	73	74	75	–	36	–	–	load (HL) with register
LD (IX+d)	DD77	DD70	DD71	DD72	DD73	DD74	DD75	–	DD36	–	–	load (IX+d) with register
LD (IY+d)	FD77	FD70	FD71	FD72	FD73	FD74	FD75	–	FD36	–	–	load (IY+d) with register
OR	B7	B0	B1	B2	B3	B4	B5	B6	F6	DD86	FD86	or register with A
OUT (C)	ED79	ED41	ED49	ED51	ED59	ED61	ED69	–	–	–	–	output register
RES 0	CB87	CB80	CB81	CB82	CB83	CB84	CB85	CB86	–	DDCB.86	FDCB.86	reset bit 0
RES 1	CB8F	CB88	CB89	CB8A	CB8B	CB8C	CB8D	CB8E	–	DDCB.8E	FDCB.8E	reset bit 1
RES 2	CB97	CB90	CB91	CB92	CB93	CB94	CB95	CB96	–	DDCB.96	FDCB.96	reset bit 2
RES 3	CB9F	CB98	CB99	CB9A	CB9B	CB9C	CB9D	CB9E	–	DDCB.9E	FDCB.9E	reset bit 3
RES 4	CBA7	CBA0	CBA1	CBA2	CBA3	CBA4	CBA5	CBA6	–	DDCB.A6	FDCB.A6	reset bit 4
RES 5	CBAF	CBA8	CBA9	CBAA	CBAB	CBAC	CBAD	CBAE	–	DDCB.AE	FDCB.AE	reset bit 5
RES 6	CBB7	CBB0	CBB1	CBB2	CBB3	CBB4	CBB5	CBB6	–	DDCB.B6	FDCB.B6	reset bit 6
RES 7	CBBF	CBB8	CBB9	CBBA	CBBB	CBBC	CBBD	CBBE	–	DDCB.BE	FDCB.BE	reset bit 7
RL	CB17	CB10	CB11	CB12	CB13	CB14	CB15	CB16	–	DDCB.16	FDCB.16	rotate left
RLC	CB07	CB00	CB01	CB02	CB03	CB04	CB05	CB06	–	DDCB.06	FDCB.06	rotate left circular
RR	CB1F	CB18	CB19	CB1A	CB1B	CB1C	CB1D	CB1E	–	DDCB.1E	FDCB.1E	rotate right
RRC	CB0F	CB08	CB09	CB0A	CB0B	CB0C	CB0D	CB0E	–	DDCB.0E	FDCB.0E	rotate right circular
SBC	9F	98	99	9A	9B	9C	9D	9E	DE	DD9E	FD9E	subtract register from A with borrow
SET 0	CBC7	CBC0	CBC1	CBC2	CBC3	CBC4	CBC5	CBC6	–	DDCB.C6	FDCB.C6	set bit 0
SET 1	CBCF	CBC8	CBC9	CBCA	CBCB	CBCC	CBCD	CBCE	–	DDCB.CE	FDCB.CE	set bit 1
SET 2	CBD7	CBD0	CBD1	CBD2	CBD3	CBD4	CBD5	CBD6	–	DDCB.D6	FDCB.D6	set bit 2
SET 3	CBDF	CBD8	CBD9	CBDA	CBDB	CBDC	CBDD	CBDE	–	DDCB.DE	FDCB.BE	set bit 3
SET 4	CBE7	CBE0	CBE1	CBE2	CBE3	CBE4	CBE5	CBE6	–	DDCB.E6	FDCB.E6	set bit 4
SET 5	CBEF	CBE8	CBE9	CBEA	CBEB	CBEC	CBED	CBEE	–	DDCB.EE	FDCB.EE	set bit 5
SET 6	CBF7	CBF0	CBF1	CBF2	CBF3	CBF4	CBF5	CBF6	–	DDCB.F6	FDCB.F6	set bit 6
SET 7	CBFF	CBF8	CBF9	CBFA	CBFB	CBFC	CBFD	CBFE	–	DDCB.FE	FDCB.FE	set bit 7
SLA	CB27	CB20	CB21	CB22	CB23	CB24	CB25	CB26	–	DDCB.26	FDCB.26	shift left arithmetic
SRA	CB2F	CB28	CB29	CB2A	CB2B	CB2C	CB2D	CB2E	–	DDCB.2E	FDCB.2E	shift right arithmetic
SRL	CB3F	CB38	CB39	CB3A	CB3B	CB3C	CB3D	CB3E	–	DDCB.3E	FDCB.3E	shift right logical
SUB	97	90	91	92	93	94	95	96	D6	DD96	FD96	subtract register from A
XOR	AF	A8	A9	AA	AB	AC	AD	AE	EE	DDAE	FDAE	exclusive-or register with A

	(PSW,A)	(B,C)	(D,E)	(H,L)	SP	IX	IY	
ADD HL	–	09	19	29	39	–	–	add pair to HL
ADD IX	–	DD09	DD19	–	DD39	DD29	–	add pair to IX
ADD IY	–	FD09	FD19	–	FD39	–	FD29	add pair to IY
ADC HL	–	ED4A	ED5A	ED6A	ED7A	–	–	add pair to HL with carry
SBC HL	–	ED42	ED52	ED62	ED72	–	–	subtract pair from HL with borrow
DEC	–	0B	1B	2B	3B	DD2B	FD2B	decrement register pair
INC	–	03	13	23	33	DD23	FD23	increment register pair
LD A, (r)	–	0A	1A	7E	–	–	–	load A indirect
LD (r), A.	–	02	12	77	–	–	–	store A indirect
LXI	–	01	11	21	31	DD21	FD21	load register pair immediate
POP	F1	C1	D1	E1	–	DDE1	FDE1	pop register pair from stack
PUSH	F5	C5	D5	E5	–	DDE5	FDE5	push register pair onto stack
LD r, (n)	–	ED4B	ED5B	2A	ED7B	DD2A	FD2A	load register pair from memory
LD (n), r	–	ED43	ED53	22	ED73	DD22	FD22	store register pair in memory

	Inc	Inc&rep.	Dec	Dec&rep.	
CP	EDA1	EDB1	EDA9	EDB9	compare, inc(dec) HL, dec BC
LD	EDA0	EDB0	EDA8	EDB8	load (DE) with (HL), inc(dec) HL and DE,dec BC
OUT	EDA3	EDB3	EDAB	EDBB	output (HL), inc(dec) HL, dec B
IN	EDA2	EDB2	EDAA	EDBA	input to (HL), inc(dec) HL, dec B

	0	1	2	3	4	5	6	7	
RST	C7	CF	D7	DF	E7	EF	F7	FF	restart call to location i*8

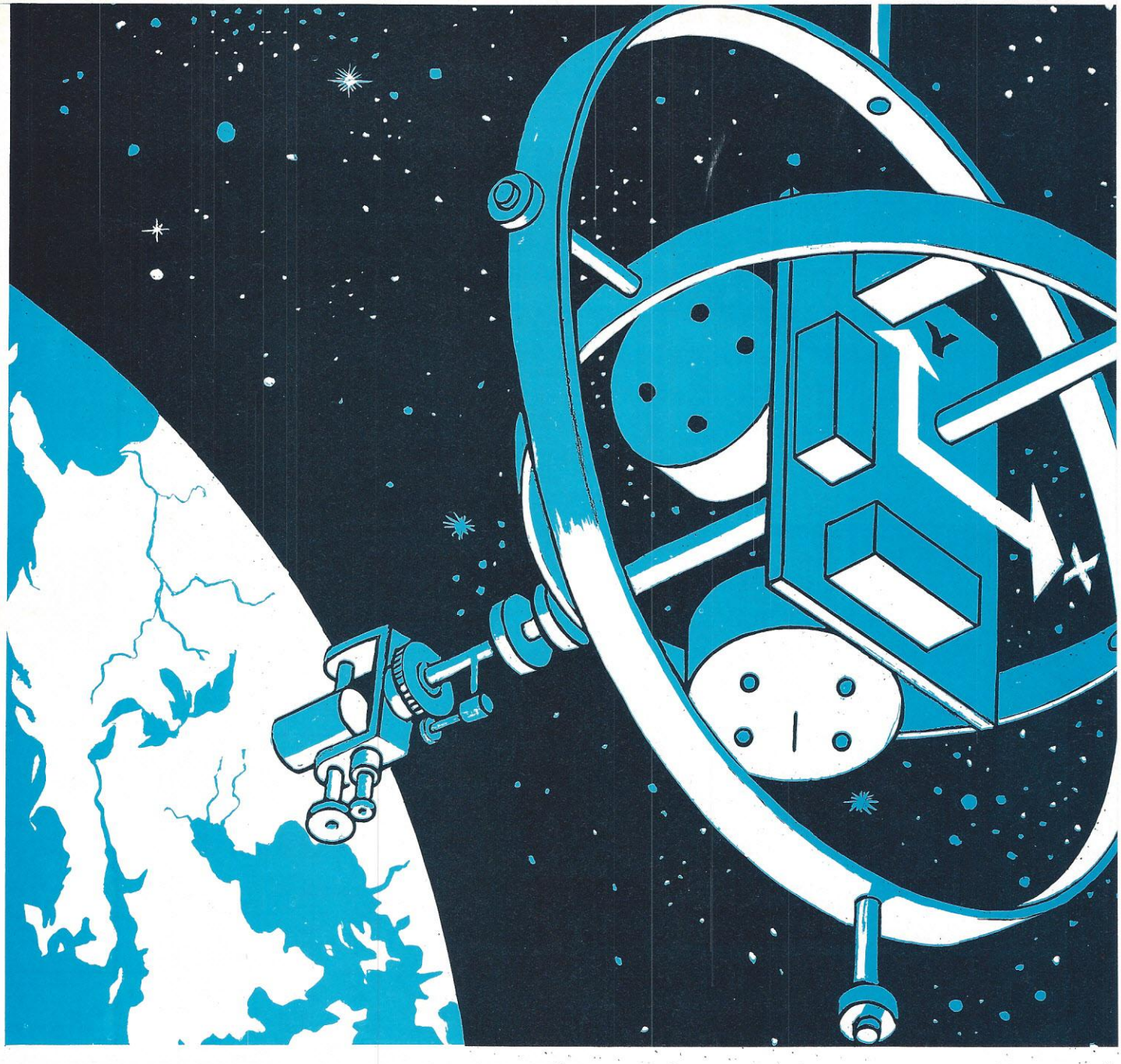
	Unc.	Zero/ Not Zero	Carry/ No Carry	Plus/ Minus	Even Parity/ Odd Parity	
CALL	CD	CC/C4	DC/D4	F4/FC	EC/E4	call subroutine if condition true
JP	C3	CA/C2	DA/D2	F2/FA	EA/E2	jump if condition true
JR	18	28/20	38/30	–	–	jump relative if condition true
RET	C9	C8/C0	D8/D0	F0/F8	E8/E0	return if condition true

CCF	3F	complement carry
CPL	2F	complement A (1's)
DAA	27	decimal adjust A
DI	F3	disable interrupts
DJNZ	10	decrement B, jump B≠0
EI	FB	enable interrupts
EX DE,HL	EB	exchange (D,E)&(H,L)
EX AF,AF'	08	exchange (A,F)&(A,F)'
EXX	D9	exchange (B,C,D,E,H,L) & (B,C,D,E,H,L)'
EX (SP), HL	E3	exchange (H,L) & top of stack
EX (SP), IX	DDE3	exchange IX & top of stack
EX (SP), IY	FDE3	exchange IY & top of stack
HALT	76	halt processor
IM0	ED46	interrupt mode 0
IM1	ED56	interrupt mode 1
IM2	ED5E	interrupt mode 2

IN	DB	input to A
JP (HL)	E9	jump to (HL)
JP (IX)	DDE9	jump to IX
JP (IY)	FDE9	jump to IY
NEG	ED44	complement A (2's)
NOP	00	no operation
OUT	D3	output from A
RETI	ED4D	return from interrupt
RETN	ED45	return for NMI interrupt
RLA	17	rotate A left thru carry
RRA	1F	rotate A right thru carry
RLCA	07	rotate A left circular
RRCA	0F	rotate A right circular
RLD	ED6F	rotate left digit
RRD	ED67	rotate right digit
SCF	37	set carry flag

Special load group, coded as LD source, destination:

A,I	ED57	A=I
A,R	ED5F	A=R
R,A	ED4F	R=A
I,A	ED47	I=A
(N),A	32	store A
A, (n)	3A	load A
SP, IX	DDF9	SP=IX
SP, IY	FDF9	SP=IY
SP, HL	F9	SP=HL



Computer modeling is a technique whereby the image of a physical system, in some sense, is constructed within a computer. There, the model is "driven" or manipulated to produce results that hopefully equal the results that would be obtained by driving or manipulating the actual physical system. A computer model could be the representation of a simple machine with its cranks, cogs, gears, levers, cams, bells and other, but computer models are usually far more complex. If the machine involved is a jet plane interacting with its environment, we then have a real problem on our hands that can tax the ingenuity of the engineers, scientists and programmers who must make the computer model.

A modern jet plane is much too complicated to be represented by a single computer model; the processes that take place in the engine alone may result in several models. One model might be for the compressor, driven by the turbine, which compresses the intake air for the engine. Another model can be for the turbine or for just one blade in the turbine. The turbine in a jet engine is by no means a simple machine. Gases are heated, fuel flows and burns, gases expand, shock waves develop in gases, a turbine blade vibrates, a blade surface erodes, and much else.

Another nasty computer modeling job is the shape of the plane's body, wings, and other surfaces interacting with the air stream at many different speeds. During the early days of aviation, many equations were developed that were known to apply to "air foils" (body, wings, rudder, and other surfaces that interact with the air) but they could not be used in the design of an airplane because their solutions were too difficult. As a result, the design of planes was primarily done by building scaled models that were tested in wind tunnels. It is perhaps of interest to know the Wright Brothers could not afford wind tunnels so they mounted their scaled models on a bicycle and observed them while they pedaled furiously down a straight road.

An example of an almost-simple problem is the design of a suspension bridge. Even this is not quite simple, because suspension bridges can oscillate from winds that blow across them, even to the point of destruction. This was vividly illustrated a number of years ago when a suspension bridge

COMPUTER MODELING

by WEBB SIMMONS

across the Tacoma Narrows in the State of Washington totally destroyed itself. Its designers were greatly suprised, along with those who were trying to drive across the bridge at the time.

This introduction will not deal with examples as complicated as jet airplanes, but will be restricted to simple tasks like the design of an atom bomb. First, consider the main mathematical tool that is needed in computer modeling. Most problems of a substantial nature in the universe are best solved, when they can be solved at all, by the use of a mathematical concept called "differential equations." This is an application of the calculus invention, difficult if not impossible. Differential equations involve more than mere quantities. They include the effects of variations in the values of the quantities and the rate at which the value of a quantity changes.

Think about a couple of examples of how differential equations might be used. Assume that an automobile has just passed a particular spot on a long straight road. Further assume that you have a remote readout of the speedometer on the car at all times. It would not be an easy task, but nevertheless it would be possible, in principle, to know the location of the car on the road at all times by just knowing the speed at all times. This in spite of speeding up, stopping for traffic lights, and slowing to observe a pretty girl. This is a *rate* problem. The speed of the vehicle shown by the speedomater is the rate at which the odometer (the direct mileage indicator) changes as "a function of" (as the result of) time, or, more strictly, the passage of time.

The velocity, or speed, of a car is not always constant. We also have a measure for the change in velocity called acceleration. A car has an accelerator, but usually has no on-board instrument with which to measure acceleration. We usually do not measure acceleration, but that is what we feel when a car speeds up, slows down, or whips around a corner. As a new problem, let us assume a car does not merely pass a point at a known speed. For the new situation, you are not to know the speed at all times before, but you are to be given the acceleration at all times from which you must surmise the speed. Then, after deducing the speed at every in-

stant in time you must surmise the location of the car at each instant in time. (Inertial guidance systems use information from accelerometers to figure out where rockets are and where they are going at any moment in time.)

Simple problems of this kind are solved in elementary college physics courses. A college freshman could appreciate the second automobile problem just given but would be hard pressed to solve it in the general case of erratic speeding, slowing, stopping, starting, etc. A typical freshman physics problem concerns the position of a freely falling body which is accelerated by the uniform pull of gravity in a vacuum. As it so happens, the pull of gravity is not uniform, a fact known to and used by Sir Isaac. Knowing that affects your calculations.

Another rate problem is a classic that is just about the first problem given to a student learning to program an analog computer. This is the swinging pendulum. When the bob, or weight, of a pendulum is displaced some certain amount, it gains potential energy by virtue of its gain in elevation. When the pendulum bob is released, it is accelerated by the pull of gravity and its supply of potential energy is converted to kinetic energy. At the bottom, the pendulum bob has no potential energy because, except for friction losses, all of its potential energy has been converted into kinetic energy. Next, the kinetic energy is again converted to potential energy as the bob moves to its maximum height on the other side of its swing.

When the pendulum is modeled on an analog computer, the effects of weight, mass, speed, height, and so forth are represented by electrical components, voltages and currents. (In fact the equivalent of a pendulum is an LC tank circuit known so well by the amateur radioman. Here "L" means inductance and "C" means capacitance. An LC tank circuit is an oscillator circuit composed of an inductor and a capacitor, often connected in parallel.) This modeling exercise is a good one, pointing out the general validity of a few basic rules of reality: mechanics, electronics, pneumatics, optics, etc. . . All operate according to the same basic rules.

An entirely different rate problem would be to plot the temperature of a pot of water on a hot plate of given wattage, or to plot the total worth of a savings account with uniform monthly deposits where compounded interest is assumed. Differential equations involve rates as well as values. The value of one quantity might determine the rate at which a different quantity changes in value. The situation can be stickier. Rather than the rate of change it can be the rate at which the *rate changes* and more. It is not necessary to understand differential equations thoroughly to understand the basics of computer modeling, but it is necessary to know that differential equations are often needed and, at least vaguely, *why* differential equations are needed. There is no way to explain a pendulum to a computer except with differential equations.

Not all computer models require differential equations. One of the first models for analog computers was for the computation of tides throughout most of the world for the benefit of ship navigation. The output was published in tables for use by ship's navigators and captains. The first non-trivial analog computer model using differential equations was for plotting ballistic trajectories of one form or another. Simply put, a ballistic trajectory is the path a bullet takes when a gun is fired. This can be complicated when many factors, such as the curvature of the earth and non-

uniform gravity, must be considered. An onerous technical problem which had to be solved to make the early analog computers successful for models expressed in differential equations was the reduction of friction in the moving mechanical elements of the computers. Undesired friction introduced error terms in the equations. Friction, or at least the effect of friction, was overcome by the introduction of exquisite servo control mechanisms. Good modeling has not been easy.

Eventually, scientists had some very important problems whose models were just plainly too complicated for any analog computer. This refers not only to the earlier semi-mechanical analog computers used to compute ballistic trajectories but also to their vacuum tube replacements. Most of these complex problems specifically dealt with the development of atomic (or nuclear) weapons, ordinarily referred to as "nuclear devices."

The best computer model includes all possible components and effects of the system or part of the system that is to be modeled. In the case of the bomb, this means that each nucleus of each and every atom must be fully described in all of its aspects. This is ridiculous on the face of it, since there are entirely too many atoms in even a small speck of uranium. Thus, even at the start, it was necessary to start making approximations to the actual physical system. These early computer models illustrate very well some of the basic procedures and problems associated with computer modeling in general.

The first problem in computer modeling is to describe the actual situation as completely as possible. Since reality cannot be modeled completely it is necessary to build another situation (or model) that is much simpler than our actual situation (or model) but yet embodies the essential features of interest in the "real" model. The simplified model of the bomb will take groups of atoms together rather than just one atom with the hope that what affects one will, at least for an approximation, affect all in the group. A word sometimes used is "zoning." The entire physical space of interest (the whole region in which the bomb exploded) is zoned like the layers in an onion with the assumption that uniform actions take place throughout a given layer. Many times the model designer will wish for thinner layers, or zones, more of them than the capacity of the computer will allow.

At length, we get a simplified model which hopefully does not lose too much in comparison with the real world. Given this conceptual model, all of the differential equations must be set up to explain the simplified model to the computer. Unfortunately, so many elaborate equations are needed that the computer is unable to handle them. Once again it becomes necessary to trim and consolidate. And again the hope is that we are not throwing out the baby with the bath water. Eventually, everything is so cut down and packed up that the computer can be programmed. A nagging question remains. Has the model retained enough similarity to reality to produce meaningful information in operation?

Coupled with the problem of computer modeling is this problem of model validation. Computer solutions must be

compared with physical experiments in order to determine whether or not the computer models are good enough. When a computer model does work well enough, it is vastly preferred to actual experiments because computer solutions are less expensive, do not waste valuable material, are less hazardous, and do not pollute. Perhaps most importantly, we can attempt computer solutions for experiments we would not dare to make.

A computer hobbyist is not likely to simulate nuclear weapons in his home so a down-to-earth physical situation might be modeled in the home. Why not model the home itself, or at least some important feature of the home. Consider just the problem of heating one room in the house. For simplicity, do not consider the other rooms in the house and futhermore don't consider cooling the room.

Make numerous simplifications. In an actual room, there will be temperature differences between the floor and ceiling and it will be warmer near the heat inlet from a heating plant or near the radiator. Ignore these complications.

With such simplifications, it seems nothing is left. You don't need a computer. You merely hook a thermostat to the heating plant downstairs, and when it is too cold the thermostat starts the central heater. This is all there is too it; at least Minneapolis-Honeywell and others who make thermostats have made a bundle under the assumption that "this is all there is to it."

The author recalls the old family house in Minnesota whose heat in the winter was obtained from an automatically stoked coal furnace via a hot water radiator system. A thermostat in the kitchen dutifully closed a switch when the temperature dropped below a selected setting. At this point, the stoker began to stoke, a blower for the furnace began to blow, and the fire in the furnace slowly began to build up. This buildup in the flames commenced to heat the hundreds of gallons of water in the radiator system and eventually a little warmth began to flow from the radiators into the rooms, one of which was the kitchen containing the thermostat, the one room considered in this model. By this time, the room temperature was much lower than that selected on the thermostat.

The coal-stoked furnace had more than sufficient capacity to heat the house; eventually, we had a rip snorting fire in the furnace with scads of hot water in both the boiler and radiators. (Note: The water did not actually ever boil, because it was a hot water system rather than a steam system.) By the time the kitchen temperature was high enough for the thermostat to open its switch, the whole joint was bouncing. Obviously, the warm house grew roasting hot after the switch was opened again, because it took some time for the furnace to stop heating the already hot water. The furnace never did shut down completely, but maintained a small residual flame.

Could a computer have helped the situation? You can bet your life! The computer would not use a thermostat, but would look at a thermometer. By reading the actual temperature at regular intervals, the computer could determine not only the temperature, but the rate at which the temperature is changing. If the present temperature in the room were too high, but dropping rapidly, the computer would start the furnace immediately, because it knows the furnace is a sluggard which takes time to become effective. Similarly, when the temperature is too low, but rising rapidly, the computer must shut the furnace down because it knows the heating

system has excess capacity and will overshoot the mark. Unlike the thermostat that knows only what the situation is at a given moment, the computer can anticipate the effects of action it takes at any given moment.

In this very simple conceptual model, dealing with control of the temperature of the kitchen, the key to success is attention to a differential equation. Calculus gives us handy terminology for this. When a value changes, the rate at which it changes is called the "first derivative." The first derivative may itself change, in fact it usually does, and the rate of this change is the "second derivative." A computer program written to control the temperature in a heated space must consider the temperature, its first derivative and its second derivative. Our discussion has considered the first derivative only (how fast is the temperature changing?) and did not mention second derivative at all. Nevertheless the best solution will require a knowledge of the second derivative also.

Mathematical derivatives must be taken with respect to some "independent" variable. The independent variable that is usually of greatest interest is time, actually the *passage* of time. In the automobile problem the first exercise was to compute its position on the road from its first derivative with respect to time, which was its velocity. The next exercise was to compute its position from knowledge of its second derivative with respect to time, which was the vehicle's acceleration. In the case of the room heating problem, the first derivative of the temperature with respect to time was the rate at which the temperature changed. There is no convenient name (like "acceleration") for the second derivative of the temperature with respect to time.

Return to the Minnesota hot water radiator system with a computer. An improved approach would be to have both a room thermometer and a hot water thermometer, each continually read by the computer. The computer would establish a "best" hot water temperature from considerations of the room temperature and its derivatives. The computer would then control the furnace, not in response to the room temperature, but in response to the desired best water temperature and its derivatives with respect to time. A home computer could easily maintain a desired room temperature within a degree around the clock in spite of the sluggishness of an old fashioned heating plant.

There is more to human comfort than mere temperature. Room humidity is important and so is radiative transfer of heat. If a room has windows, and sunshine is streaming in on a bright day, the actual air temperature required for greatest comfort will be lower than if it is a cloudy, drizzly day. In the first case, the human body itself gains warmth from the sun's radiation streaming in through the windows and in the second case one's body loses heat by its radiation streaming out through the windows. Thus the computer may require other sensors than the two thermometers. As a matter of fact it needs at least one more thermometer, maybe two. What causes a room to cool so much as to require heat to be supplied? Generally the cause is a low temperature outside that saps the heat through the walls of the house. Surely the outside air temperature would be valuable input to our system, as might be the temperature of the furnace itself in

addition to the temperature of the water. Even stripping out consideration of many real factors, we find this simple model for controlling heat in one room growing complex.

A computer model for heating the entire home must consider more. Each room must have a thermometer, and the computer must control servo mechanisms to adjust the relative heat distribution throughout the house. Rooms known to be vacant need not be heated to comfort level and all room should perhaps be cooler after everyone has gone to bed. The computer can make scheduled adjustments based upon the time of day and perhaps the day of the week, but in addition the people must be able to tell the computer, "We will stay up a little late tonight." Certain complications will be added if the computer also controls cooling, exercise humidity control and perhaps ionic control (injecting negative ions into the ventilating system).

A complete comfort control computer must contain several dynamic models, all of which handle the appropriate differential equations. It will need a model for each of the rooms, a model for the heating plant and a model for the cooling plant. If the heating plant is complicated, each of its elements (furnace, boiler, water pump, etc.) might require separate models, and, of course, ditto for the cooling plant.

Having developed a feel for differential equations and for the general nature of problems that must be faced in modeling, return once again to the construction and application of nuclear bombs. Models of systems that cause action on a dramatic scale are always especially interesting.

Figure 1 shows the onion model of a simplified implosion fusion bomb. The simple theory says that if we squeeze a sufficient amount of plutonium enough, the system will go "critical" and we will get a big bang. There is a bit more to it than this but the explanation is sufficient for the present purpose. The model in Figure 1 is composed of layers all the way from the surface to the center. The various layers are not necessarily of the same thickness even within a single material. It is not

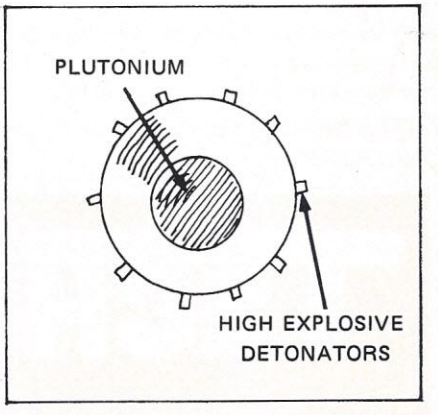


Figure 1 A model of an implosion fusion bomb.

usual for a single peel to be composed partly of H.E. (high explosive) and Pu (plutonium) in a model such as this; however, it is sometimes desirable to represent several materials.

Unlikely as it may seem, a model such as Figure 1 is considered to be one dimensional (1D). Naturally, everyone knows the bomb is a sphere and occupies three dimensional space; however, any single radius line from the center to the surface is exactly the same as any other radius line and it suffices to describe only one (any one) of these. Initially the problem (the model) is described in terms of the physical radius from the center to the surface but when the model becomes active the various peels move inward or outward in response to various events.

Assume the bomb model of Figure 1 is actually a low altitude burst over some small city such as Peterborough, NH (to use an eastern example). At early times, we can use the ID model of Figure 1. Eventually, the energy density is so diluted, and the bomb mass is so dispersed by expansion and thermal radiation, that the atmosphere begins to have an appreciable effect. At that time, we must construct a larger onion model. The ending conditions for the first model will become the initial conditions for the second model.

At still later times, we encounter effects which force us to relinquish the ID model in favor of a 2D (two dimensional) model. In Figure 2 notice the surface of the ground that will interact with the fireball, and will reflect shock waves and absorb radiation from the bomb. The model might also include the fact that air density goes down at higher altitudes. In any case, one can shift to tubular or cylindrical geometry in which the tubes are further sliced into rings. Generally speaking each tube differs from all others and each ring of each tube differs from all others.

The decision to shift from one basic model to another is never made lightly, because such shifts always cause complicated problems. Unless great care is exercised, the model may inadvertently

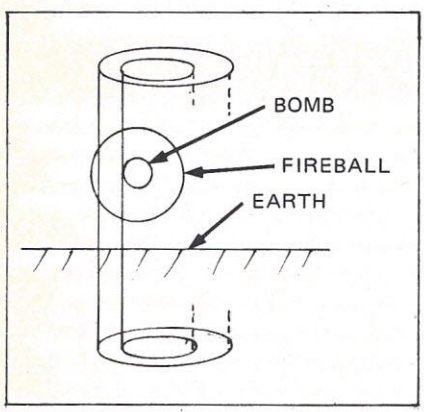


Figure 2 2D model when external considerations force the abandonment of a simple spherical model.

gain or lose energy, mass, momentum, or other feautres that must be conserved. Also, note that the number of zones or cells for which individual computations must be made will increase enormously for the 2D model as compared with the 1D model.

In spite of the complexity of these models, they actually work. Computers don't lose interest in long drawn out calculations, they keep plugging until the job is finished. If the conceptual model is good, the calculations will be useful.

If modeling nuclear weaponry and jet airplanes seems far beyond the scope of our little personal computing systems, recall this: The hydrogen bomb was modeled on computers before it was first constructed and tested. A participant in that work mused recently, "Ulam and Teller knew it would work, and were completely confident before the first device was tested. The computers had shown them a working model." That was in the early fifties.

The first commercial computer using transistors instead of tubes didn't come to market until 1959. The computers on which the hydrogen bomb was modeled were physical monsters, but slow and clumsy, with limited capacity by the standards even of today's personal computers. Now tens of thousands of private experimenters can run complex models of their concepts, making hundreds of important changes inexpensively before they mount scaled models on their bicycles and begin to pedal in earnest.

Put More English In Your Programs

suggestions for programs documentation

by Anthony Abowd

Anyone who sees a computer program for the first time is baffled. It looks like a foreign language. Listings of computer programs are full of strange words and symbols, occasionally punctuated by an English phrase.

Those occasional English phrases comment about what is going on in the program; they are written so that ordinary human beings can better understand the program. If these comments are properly presented, anybody can "translate" the entire program without knowing anything about computer languages. Comments and other plain English explanations of a program are part of program documentations.

enough is never enough

Documentation is the curse of every programmer. You can never explain enough. If you can't follow your own program, just a few days after you wrote it, you did not document it properly. If you cannot make sense of other people's programs, they did not document them properly.

The world's toughest task is to read and revise somebody else's computer program. It is tough enough to scan the listing to figure out the logic behind the program, but things are not made any easier by the cryptic abbreviations the author used for the assorted variables. To top everything off, most personal computer systems are chronically short on storage space. The program ends up a condensed mess.

the software schematic

Documentation is the software equivalent of a hardware schematic diagram. A schematic is that funny looking drawing of lines and symbols that explains the electronic layout of the system. An engineer would be a fool to tinker with the circuits of his computer system without the guidance a schematic diagram gives. Any company that does not supply a schematic diagram with its equipment is penalizing the person who wants to revise or repair his own equipment.

The same is true for computer programs. If no documentation exists, repair or revision of the program is particularly difficult. Few can follow a computer program of more than a dozen lines without some words of guidance written in the margin, or included in the program listing itself.

The time to document is when the program is initially written, not after the thing is a hopeless maze of abbreviations, countless branches and confusing conditional tests.

some suggestions

What *is* good documentation? This depends on the language you are using. For Assembly language, the language closest to the actual instructions the computer understands, documentation means a comment on *every* line of the program. This may sound like a bit much, but the simple rule of thumb for good documentation is: the more documentation, the better. For Assembly language, "more" means some words of wisdom on every line. What may seem like a redundant comment for you may be very helpful to the guy who has to find the error you did not find in your work.

Higher level languages, such as BASIC or FORTRAN are supposed to be more understandable to the reader. This is why the "higher level" languages evolved in the first place. But BASIC, for most personal computers, permits variable names that are only one or two letters long. When storage requirements for personal computer systems force the programmer to omit remarks entirely in some cases, this "higher level" language is not any more understandable than Assembly language. The rule of thumb applies here also. Use more documentation.

think first

Most rookie programmers find documentation difficult because they write terrible programs in the first place. Beginning programmers find it hard to make other people understand what's going on in their programs when they don't even know themselves. The best aid to good documentation is a well planned program. This simplifies documentation considerably. The extra time you spend just thinking about your program pays off.

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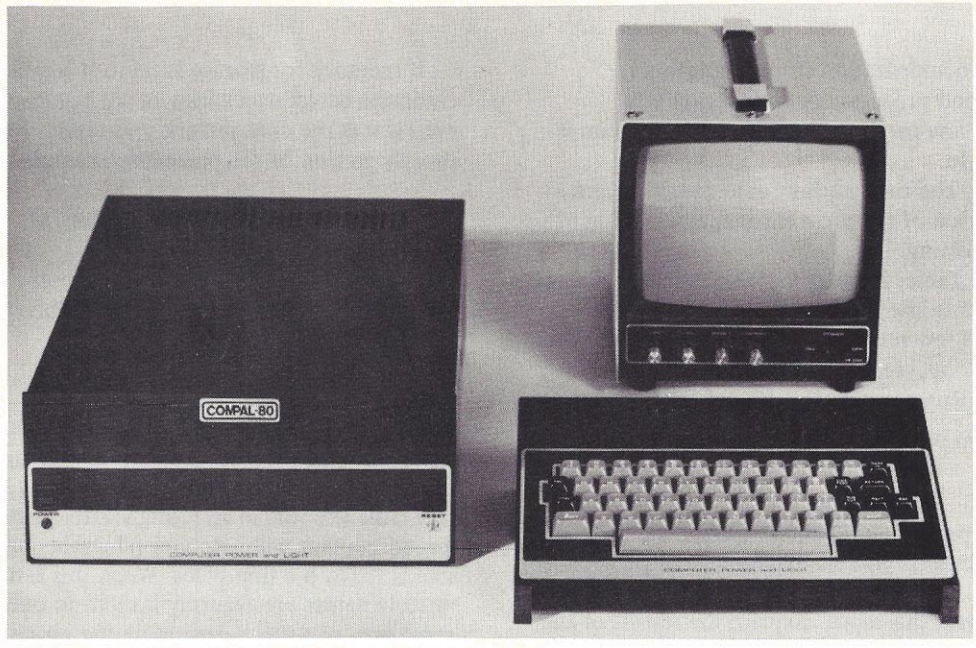

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CIRCLE 32

extract adequate documentation from our authors.

The basics of good program documentation are:

1. The Intro. A few paragraphs of what the program is supposed to do.
2. The Heading. The title, author, date, language and a brief description of the program at the beginning of the program listing.
3. The Variable Table. A list of variable names and what they stand for in the program.
4. Comments. A few remarks, stored in the program, for every major loop, section and subroutine.
5. The List and Run. An actual listing of the program followed by an actual run of the program.

the intro

The Intro is a few paragraphs explaining what the program is supposed to do. Act as if you are explaining the program to a complete novice. Tell what the program requires for input and what it does with this input. Explain the results of the program. All the examples that follow document the same program.

example of an intro:

> This program, written in Altair BASIC, Version 4.1, puts a list of numbers in order, from smallest to largest. You select the number of numbers in the list. (The maximum is 100.) Then enter each number individually. Results are printed on your screen, or printer, after the last number has been entered.
>
> Please be careful when entering the numbers. If an alphabetic or other illegal character is entered, the program may not work right.
>
> If the list has more than 100 numbers, change the 100 in lines 60, 100 and 140 to whatever number you want. The program gives you the option to enter other lists after the first one is ordered.

Notice how these brief paragraphs tell what the program does, what you have to do to use it and some of the common errors or corrections that are encountered. This explanation is not part of the program. It is separately filed where a potential user can read it. Explanations for all your programs should be in a program documentation library.

the program heading

The Program Heading includes the initial remarks in the program itself. This is a vital part of the program listing. It tells the name of the program and, briefly, what the program does. Also in the Program Heading is the author's name, the programming language, the date the program was written and any revision history for the program. (Any program that does not freely list the author may well have been swiped, its true author lost in obscurity.)

This is what a Program Heading looks like in BASIC for the example program:

```
10 REM THIS IS AN INTERACTIVE, SMALLEST TO LARGEST.....
20 REM WRITTEN IN ALTAIR BASIC, MAY, 1977 BY A. ABOWD
30 REM CHANGE THE 100 IN LINES 60, 100 and 140 ....
40 REM LATEST REVISION: JUNE, 1977 BY A. ABOWD
```

If memory for storage is tight, it is still important to include the barest necessities at the beginning of the program, even if it is the *only* remark you retain. For example, a shorter version of the preceding example could be:

```
05 REM SORT: BASIC, 6/77 A. ABOWD. SEE DOC #77.18.
```

The basics are condensed but still present. This remark also refers the reader to some document library where more information can be found.

the variable table

The Variable Table is a list of variable names and what they stand for. The best high level computer languages let you use any name, in any length, to represent variables in the program. The rule in selecting variable names is to choose something that will help you remember what the variable stands for in the first place. When this is not possible, or variable names are absurdly limited to only a few letters, some way of further describing the variables is needed. A simple table, relating the variable name to the actual data the variable will contain, helps ease identification problems. Usually, such a table is arranged in alphabetical order and, if space permits, the important variables are actually included in the program listing itself.

This is what a Variable Table looks like:

```
A$          ; Answer to the question asking for another list.
I           ; Index variable for several loops.
J           ; Index variable for the nested loop.
N           ; Number of numbers in the list.
T           ; Temporary variable name used when positions
            ; need to be swapped in X.
X(100)      ; The data array that will be ordered. The
            ; results of the ordering are also contained
            ; in this array.
```

If such a table is not included in the program listing, it should be included in the written material for the documentation library.

comments

Comments are remarks inside the program. Internal comments are often left out because the original author is lazy or has no desire to make life any easier for people who have to fix the program. If comments do interfere with space limitations, take them out of the version of the program that you run *but* leave them in the presentation for the documentation library.

Most FOR or DO loops need some kind of explanation. They also tend to be the processing crux of most programs. Subroutines and functions should also have some comments about what they do. Important IF statements should also include some remark about what they are doing in the program. For example, a section of the sample program looks like this:

```
 60 DIM X(100)
 70 REM
 80 REM X HOLDS DATA. N IS SIZE OF LIST.
 90 REM
100 INPUT "HOW MANY NUMBERS (100 IS MAXIMUM) WILL BE
    ORDERED"; N
```

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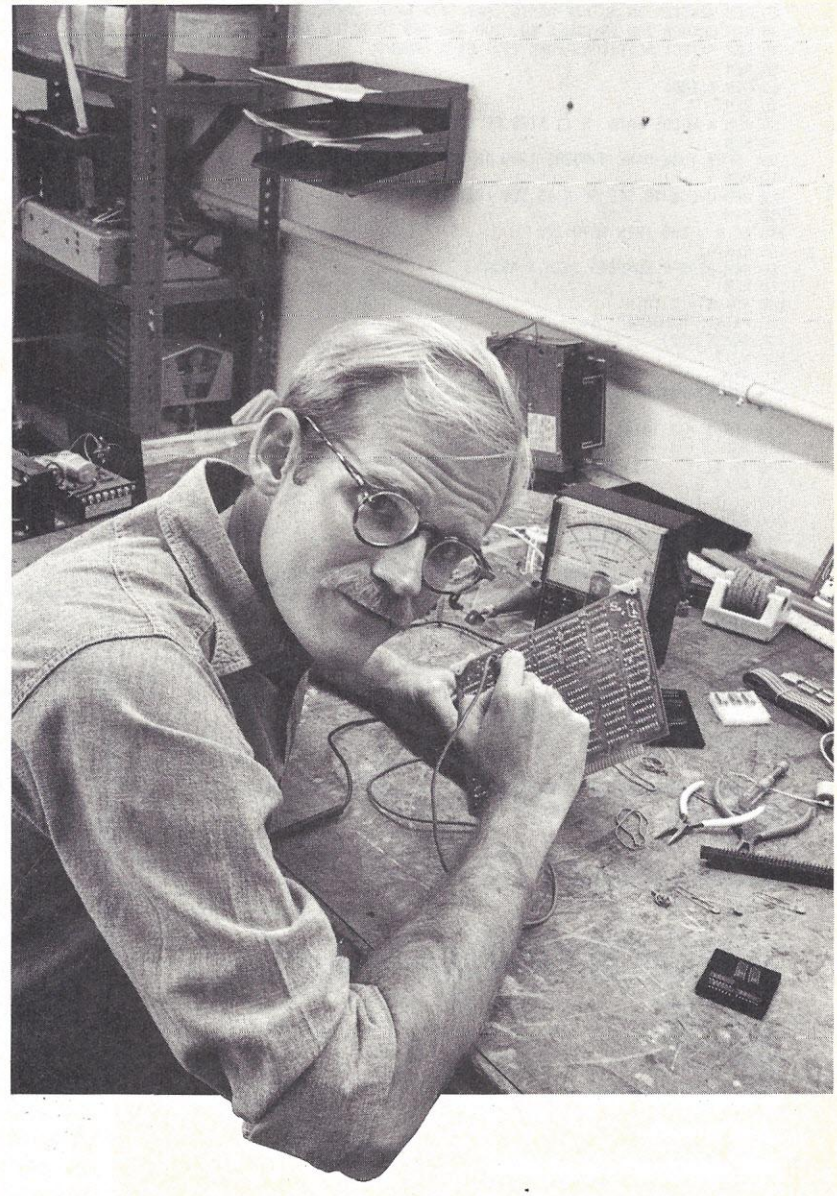

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CIRCLE 33

```
110 REM
120 REM CHECK TO SEE IF N IS TOO LARGE.
130 REM
140 IF N   100 THEN GOTO 100
```

listing and run

This part of documentation almost seems obvious but is often left out. This means simply to list the program and follow it with an actual run to show most of the tricks the program can do. Handwritten, or even typewritten, versions of programs have the curious property of being almost always wrong. At least with a program listing and a run, the user knows that the program worked once, on somebody's computer. This is very reassuring, especially if you can't find the reason your version is not working. For a listing and run of the example program see the figure below.

```
 10 REM SORT, AN INTERACTIVE, SMALLEST TO LARGEST, ORDERING ROUTINE.
 20 REM WRITTEN IN ALTAIR BASIC, MAY 1977 BY A. ABOWD.
 30 REM CHANGE 100 IN LINES 60, 100 AND 140 TO ALTER MAXIMUM LIST SIZE.
 40 REM LATEST REVISION, JUNE 1977 BY A. ABOWD.
 50 REM
 60 DIM X(100)
 70 REM
 80 REM X HOLDS DATA. N IS SIZE OF LIST.
 90 REM
100 INPUT "HOW MANY NUMBERS (100 IS MAXIMUM) WILL BE ORDERED"; N
110 REM
120 REM CHECK TO SEE IF N IS TOO LARGE.
130 REM
140 IF N   100 THEN GOTO 100
150 REM
160 REM READ N NUMBERS INTO X ARRAY.
170 REM
180 FOR I = 1 TO N
190 PRINT "NUMBERS"; I;
200 INPUT X(I)
210 NEXT I
220 REM
230 REM STANDARD, ONE ARRAY SORT, FROM SMALLEST TO LARGEST.
240 REM
250 FOR I = 1 TO N - 1
260 FOR J = I + 1 TO N
270 IF X(J)   X(I) THEN T = X(I): X(I) = X(J): X(J) = T
280 NEXT J
290 NEXT I
300 REM
310 REM X IS NOW ORDERED. PRINT EACH NUMBER.
320 REM
330 PRINT: PRINT "ORDERED LIST OF NUMBERS": PRINT:PRINT
340 FOR I = 1 TO N
350 PRINT X(I);
360 NEXT I
370 REM
380 REM USER CAN DO ANOTHER LIST.
390 REM
400 PRINT: INPUT "WANT ANOTHER LIST (YES OR NO)"; A$
410 IF LEFT$(A$,1) = "Y" THEN GOTO 100
420 END


HOW MANY NUMBERS (100 IS MAXIMUM) WILL BE ORDERED? 3
NUMBER 1 ? 4
NUMBER 2 ? 77
NUMBER 3 ? 3

ORDERED LIST OF NUMBERS:

 3  4  77

WANT ANOTHER LIST (YES OR NO)?YES
HOW MANY NUMBERS (100 IS MAXIMUM) WILL BE ORDERED? 5
NUMBER 1 ? 56
NUMBER 2 ? 74
NUMBER 3 ? 89
NUMBER 4 ? 2
NUMBER 5 ? 45

ORDERED LIST OF NUMBERS:

 2  45  56  74  89

WANT ANOTHER LIST (YES OR NO)?NO
```

beyond the basics

These are the basics and more documentation is always helpful. Additions include: flow diagrams, a history of revisions of the program or a full scale operator's manual.

The flow diagram is a simple graphic illustration of your program. Symbols for flow diagrams are standardized to represent different common computer operations. If you are careful in writing your program, you should already have a simple flow diagram. If you cannot diagram your program, it is probably more complicated than it should be. Various products help you draw a flow diagram but one of the best is a new product called FICKLED THINKING AIDS. (See Box). This helps you design an attractive and correct flow diagram and makes revision easier. The flow diagram of the example program is shown in the figure in the box below.

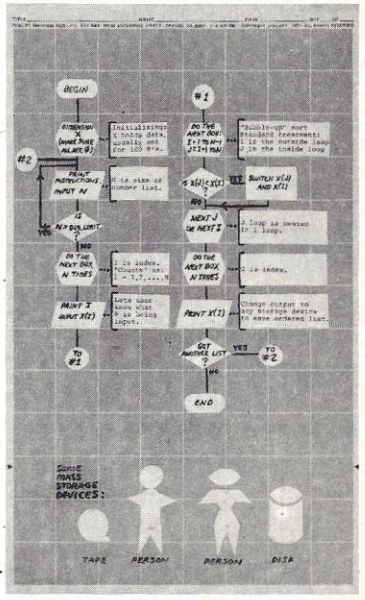
If you are writing a very big program, for example a new Star Trek game or your own programming language, you will need to write a User's Manual. Ideally, the User's Manual contains all you would ever need to know about using and revising the program. Such an ideal is rarely reached, however. Often what passes for a User's Manual these days is an unorganized collection of some random thoughts of the author. Most manuals are also full of technical gibberish instead of common English.

The primary burden to document decently falls on the original author. Users can exert some influence, especially if they purchase the program. It is a terrible oversight to buy a program without looking at the documentation. If you want to discipline program authors, don't buy programs with bad documentation. If you are a program author, hoping to sell your work, you may find the resistance of potential customers lessened if you follow these documentation guidelines.

DOCUMENTATION

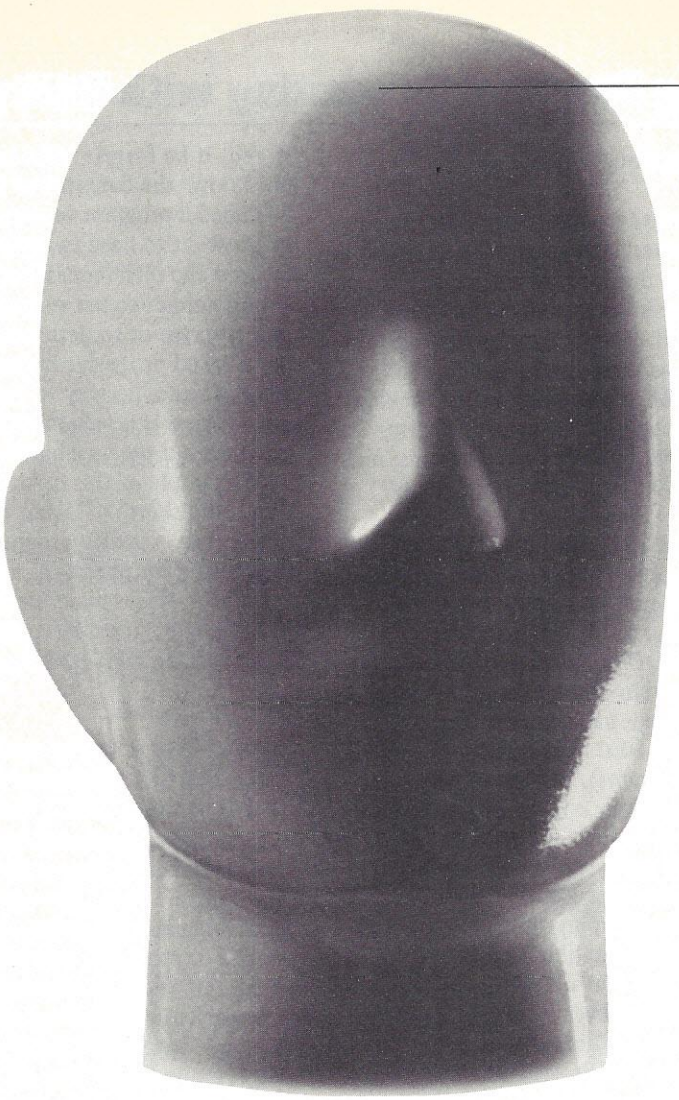
Documentation is usually a pain in the neck. Especially flowcharts; just when you think you have done a nice one, you realize you left something out. Changing a traditional, hand-drawn flowchart means doing the whole thing over again.

Designs and revisions of flowcharts are made much easier by a new product called FICKLED THINKING AIDS (P.O. Box 6064, Orange, CA 92667). Their Starter Kit comes with a vinyl folder containing 550 standard flowchart symbols in vinyl and a pad of 10 reusable, 8½ by 14", worksheets. The vinyl symbols are arranged on the worksheets to represent your computer program. Both the symbols and the worksheets can be written on, but only the worksheets erase easily for reuse.



Ball point pens, china marking pencils and permanent felt tip markers work best on the surfaces. The sheets of symbols distort if they are not kept flat and away from heat. The Starter Kit is $8.95 plus $1.00 handling. Four sizes of worksheets and more symbols in three different sizes are also available to replenish your supplies.

If you doodle on your flow diagrams, this product can also accommodate you. Various standard symbols and some scraps let you design a really personal flow diagram like the figure.



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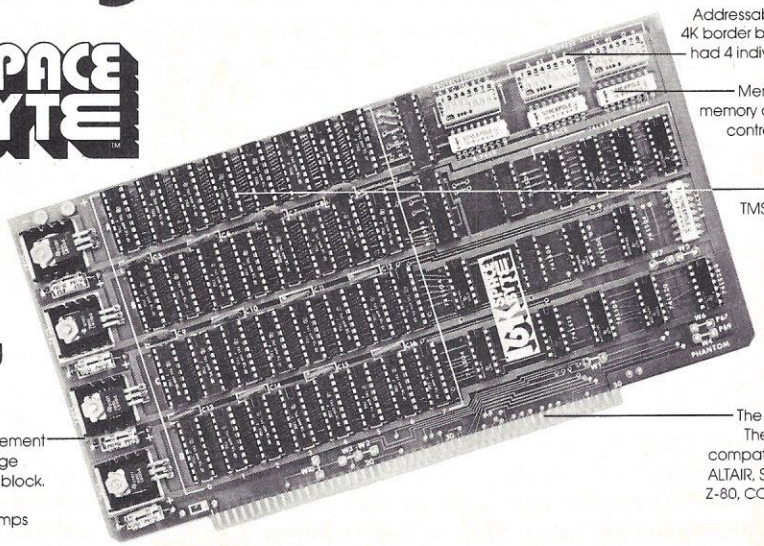

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CIRCLE 34

Simplifying Personal Computing with Utility Programs

by Bill Gates, President, Microsoft, Inc.

Utility software includes a wide range of programs that aid computer users in performing common tasks. Most users don't worry about utility software until they need to copy a file or test out a cassette interface. If utility software has been provided, tasks such as these can be handled in seconds by running the appropriate utility package and giving a short command. Without the utility software, users must write their own programs, requiring a high level of sophistication and a large time investment.

Because most users aren't aware of the need for utility software, it is seldom provided on low cost systems. On large systems the utility software is often the determining factor in how easy a machine is to use. For example, Digital Equipment Corporation's (DEC) Decsystem-10, a large scale computer costing over $1.4 million, has almost a hundred utility programs which DEC calls CUSPS (Comonly Used System Programs), such as DDT (Dynamic Debugging Technique), FRS (File Recovery System), CREF (Cross Reference) and FILCOM (File Compare). Many users find the Decsystem-10 versatile and easy-to-use because of these programs.

Some users of personal computing systems who work with only one language like BASIC, which has a built-in editor, feel that BASIC gives them everything they need. However, utility programs are very important even in this environment. If a BASIC doesn't provide RESEQUENCE or RENUMBER, to change line numbers, a utility program can be written to perform this function. What BASIC runs diagnostics on all hardware devices or allows all references to a variable like "pay" in a program to be changed to "yearly pay?" Most utilities can be written in BASIC, so they are easily modified; these utilities can then be activated with a simple "RUN" command. As an example, a diagnostic program can use the INP and OUT functions present in most BASICs to access special hardware hooked up to a system.

Stored Files

Many utility programs are designed to work with stored files; they can copy an entire cassette or floppy disk for backup purposes or to send to a friend. Some BASICs and Disk Operating Systems (DOS) allow a listing of the names of the files stored on disk to be printed, but what if an alphabetic listing of files or a listing in order of size or creation date is desired? A user of cassette tape might want a listing of programs on his tape or might want to find out where a certain program is stored. If he forgets what he named a program, but knows the contents of the first line in it, he will need a program to search the tape. A user might want to have two programs compared and to print the differences between them. This allows a programmer to see what changes have been made in a program or to determine if a "copy" command has worked properly. In some cases, a BASIC or DOS provides no way to determine the length of a file. Since this is valuable information, a utility must extend the capabilities of the BASIC or DOS – an example of this is Altair Disk Extended Basic. On each diskette of Altair Disk Extended Basic that is sold, a utility program written in BASIC called PIP (Peripheral Interchange Program) is present. PIP provides many utility functions such as LEN (length) or COP (copy), neither of which can be performed with BASIC commands.

Cross References

Another kind of utility package is a cross-reference (CREF). Most personal computer users haven't heard of CREF, because it isn't available on personal computer systems. A CREF provides an alphabetical listing of all the variables, arrays, function names and line numbers used in a program, showing where they are referenced and defined. For programs shorter than thirty lines, a CREF can easily be obtained by examining the program listing. However, when a program, whether written in BASIC, FORTRAN or any other language, grows larger than fifty lines, a CREF becomes invaluable. Questions like "Am I still using RCOUNT anywhere?" or "Where is FNCD defined?" or "Are there any GOTO's to line 1136?" can be answered with a glance at the CREF. After using a powerful tool like CREF, programmers will usually insist that it be provided on every system they use. After learning that the computer can eliminate the time used in searching a listing, a programmer finds this a menial task that the machine should handle.

Editors

Another common type of utility program is the editor. An editor provides commands to read in a text file from storage, modify it and write it out to storage. All editors provide capabilities for deleting, inserting, moving, printing, copying and replacing blocks of text.

Most BASICs use a built-in primitive text editor. When a new line is typed in, it is inserted into the appropriate place in the program. If an already existing line is typed in, the old version is replaced. Typing a blank line deletes any previous copy of

Software Column

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the line. The LIST command prints portions of the text; LOAD and SAVE are used to read and then write the program text onto a storage device. Extended BASICs often provide an "EDIT" command, allowing portions of an incorrect line to be modified without retyping the entire line. This is another feature that many

Software Column

users find addictive. Retyping one hundred characters just because of one mistake seems reasonable if you're told, "That's how the computer makes you do it," but once a user learns this is false, he'll complain about being forced through a mechanical retyping process that can be avoided.

Most text editors have a much broader range of capabilities than the editors built into BASIC. Substituting a new string for every occurrence of an old string can usually be done in a single command. For example, if you've just written a thousand-line text that refers to "BASIC" in small letters several places and you decide it should be capitalized everywhere it appears, one "search and substitute" command will correct this. Another advanced capability is moving the position of a block of text. If a subroutine in a program or a paragraph in a letter occurs out of place, a "transfer" command moves it to the proper place. A very fancy editor justifies left and right margins, centers headings and divides a document into pages of equal size. Currently only Vector Graphic and Technical Design Labs provide advanced text editors, which is suprising considering how basic an editor is. An ambitious user of an Extended BASIC could write an advanced text editor in a program a few hundred lines long.

Maintenance

Users are least aware of maintenance software. Maintenance software tests out computer system components, determining if they are working, and, if not, how they are malfunctioning. When a computer fails to run an accounting program and "bombs" out any one of the many input/output devices, the memory, the software or even the computer itself could be responsible. The only way to determine where the problem lies is to exercise each component in the system. Straightforward tests often fail to detect a subtle failure that large programs will trigger. As an example, many users of personal computers who suspected their memories were failing wrote programs storing a number into every memory location and then reading it back. These tests would always succeed, so these users vainly turned to other system components to try to find their problem. In fact, the memory chips that were responsible were allowing the presence of 15 1's in some memory cells to cause other cells to change from 0 to 1! To find this kind of failure, a user would either perform an exhaustive test, which might take months, or read some very technical literature outlining tests that would catch bad memory chips. If the maintenance utility had been provided, the bad memory chip could have been spotted within minutes. Instead, the only choice was to ship the entire system back to the manufacturer. This poses a major problem when the computer was made by one company, the memory by another and the input/output devices by still another. Maintenance software is usually quite simple if written by someone who understands the device being tested. In some cases manufacturers have in-house maintenance software that isn't distributed to users because it takes time and effort.

The Need

A system with a single software package falls far short of its potential capabilities. The availability of utility programs significantly enhances the power of a system. These programs are easy to use and yet are very powerful. Though this has been largely ignored to date in the personal computer field, it will soon change. The idea of using software that helps to write software . . . may be somewhat confusing to a novice user, but is key to bringing the computer to a level of usability that makes it attractive to people without a technical background. Utility programs can be made transparent to the user through a cleverly designed command language package. However, this may be some time coming in a field that hasn't yet developed many of the essential utility packages.

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Charge my: ☐ Master Charge ☐ Bank Americard
Account # _____
Card expiration date _____

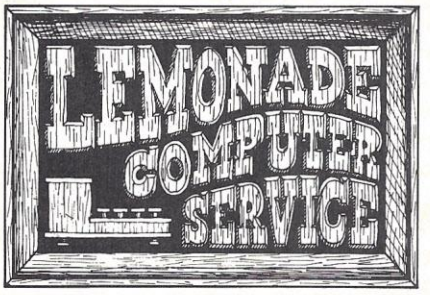
Please remit in US funds — Thank you

☐ **Bill me**
☐ **Check enclosed** (you'll receive one extra issue for each year!)
please allow two months for processing.

MAIL TO: PERSONAL COMPUTING, 167 COREY ROAD, BROOKLINE, MASS. 02146.

Illustration by Danielle Jossette Coen

Happy Holidays



The Holiday Inn people must feel that their cup runneth over with peculiar publicity. The conversion of the Beirut Holiday Inn to a fortress during the recent Lebanese Civil War certainly provided some of the more ironic news reports of our era. "Troops firing from the beleaguered Holiday Inn . . . Mortar attacks on The Holiday Inn stronghold . . ." and similar lines in the national television news must not have soothed management ulcers at headquarters in Memphis.

Perhaps morale can be raised by a report on the more positive acitvities of a sometime Holiday Inn guest, Mark James. (Mark is Program Director/Computer Specialist at USC's COMEX, whose Lemonade program, DOTS, was presented in the last issue of PERSONAL COMPUTING.)

Mark was wiling away a dull evening in a strange city by reading in his hotel room when it occurred to him that he could deal with matrix puzzles in the magazines by putting his computer to work on them. He didn't have a terminal in his suitcase for access to the great big IBM 370 with which COMEX is blessed but he sketched out two programs that evening, naming them Holiday Inn-Part One and Holiday Inn-Part Two in honor of his host and the occasion.

When he got back to his office, he knocked out the completed programs in FORTRAN IV, debugged them and documented them handsomely so that any Lemonade Entrepreneur can under-

stand the logic and get translations of the programs up and running on his own system.

Is it worth all the trouble for these dumb little puzzles? Well, every town has a newpaper of some sort, every social organization a newsletter and every company of any size a house organ of some kind. Each group has a special vocabulary of its own, a list of names with special significance to its members and short phrases fraught with special meaning.

What publication would not welcome custom designed word puzzles contrived from lists they provide? The names of the city councilmen and civic officials of any town are worth a run in the newspaper at least once. The Exalted Ruler of the Elks and his retinue can be rendered in puzzle form; and wouldn't the Elks be happy to pay a few dollars for camera-ready copy of the puzzle to run in one of their publications?

Does the computer club want to help novices learn the jargon? Let them work with those puzzles that reinforce their learning.

No law of Man or Nature requires the word list to be in English. The German, French, or Spanish teacher at the local high school may want to assemble a textbook offering vocabulary drills in this form. Maybe you can share in the revenue from the book if you employ your computer to create interesting and effective language exercises. (No need to stick with connected-word puzzles; computer-manipulated words and numbers in a hundred forms might be interesting and effective.)

Mark James suggested that PERSONAL COMPUTING send him a list of words that are important in this field. The following puzzle matrix came back by return mail. Can you pick out the twenty-five meaningful combinations of letters that may run forward, backward, up, down or diagonally?

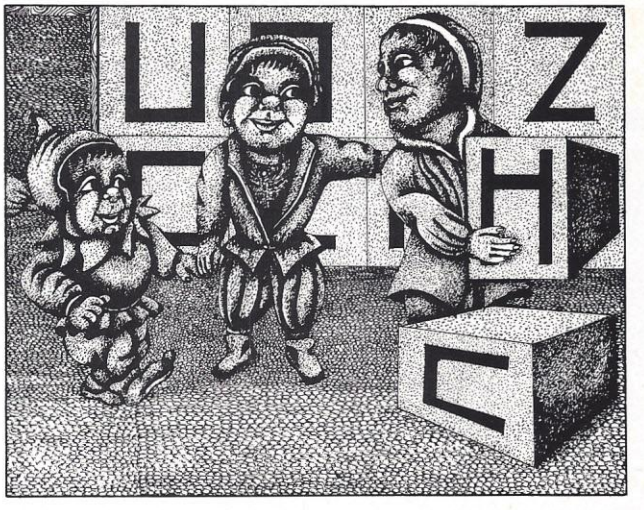
```
S T F E P R E V I T C A R E T N I K L I N G O N N
T I P F Z G Z W B S P A G H E T T I J M H Q A D Z
D N O C E S O N A N W O W M D P C D H E F A H D X
O F J U S Y O M I U K G R L K I G T U C R K U Y I
N A L I N I E D A N O M E L N D G P H D N V G O H
L T R O S S E C O R P O R C I M I I E N P A Z K K
A T B T S S V O D E P Y J D C S M B T D J Z V Y A
N T R V G H X S R M Q Z I Z T C U L K A H H H Y O
O C D G Y Q N I F K F R F I C G N G L Y L V D O R
S V I F C N P M P E O O C N M H O O E C Y A G U M
P K L M R H D U V B Q S G H B Q B O I N G X F K F
E Q Y V E A Y P R A P P L I C A T I O N S I H M O
P Y N P V E F S O M Q A E J N C N L E S Q C C Q N
P D A I K M E F B C E C O T Q U Z Y R X B X K E M
C L E N L M T P O V I N V N O L P K A H A C H M G
W L P L R I U S T Q N L M Q D W F N W L S X Z O M
I U M S I Z P R E M B P Q T X O W P T A I Z W K U
T X E M A X M X E R B Y G Z E B N Z F E C X S Y J
I F F A Y C C C O M P A T I B L E E O R L G C O C
P I L B Y V C Y A E X S H E G R P V S Z A X V E H
A H C G P U V T C A R B G S Z S X V X L C H A M R
C M P C C P K O K D V U K E Y B O A R D Y E C D B
R E P X J W X W X P Y F X D C K E Z F Z N K U Q T
T S Y B D N X Y T B R F S O M Y N M N G T A Y K C
I Q P R O G R A M Q F S P R O M R P H L V X J R I
```

Here's the list:

MICROPROCESSOR	SOFTWARE	DEBUG
APPLICATION	KEYBOARD	PROM
INTERACTIVE	COMPUTER	BYTE
NANOSECOND	LEMONADE	FLOPPY
COMPATIBLE	TURNKEY	LOGIC
PERIPHERAL	PERSONAL	CRT
SPAGHETTI	KLINGON	BASIC
HEURISTIC	PROGRAM	ROBOT
	DIGITAL	

. . . and here's the layout of the words in the 25 x 25 matrix without the confusion-factor letters that fill in the rest of the matrix.

```
* * * * * * E V I T C A R E T N I K L I N G O N *
* * * * * * * * * S P A G H E T T I * * H * * * *
D N O C E S O N A N * * * * D * * * * E * * * * *
* * * * * * * * * * * * * * * I * * U * * * * * *
* * * * * * E D A N O M E L * * G R * D * * * * *
L * R O S S E C O R P O R C I M I I E * * * * * *
A * * * * * * * * E * * * * * S * B T * * * * * *
N * * * * * * * R * * * * * T * U * * A * * * * *
O * * * * * * I * * * * * I * G * * L * L * * * *
S * * * * * P * * * * * * C * * * * * * O * * * *
R * * * * H * * * * * * * * * * * * * * G * * * *
E * * * E * Y * R A P P L I C A T I O N * I * * *
P * * R * E R * O * * * * * * * * * E * * * C * *
* * A * K * E * B * * * * * * * * * R * B * * * *
* L * N * * T * O * * * * * * * * * A * A * * * *
* * R * * * U * T * * * * * * * * * W * S * * * *
* U * * * * P * * * B * * * * * * * T * I * * * *
T * * * * M * * * * Y * * * * * * * F * C * * * *
* * F * * * C C O M P A T I B L E * O * * * * * *
* * L * * * C * * * * * A * E * * * * S * * * * * *
* * O * * * * * * * * * * * * * * * * * * * * * *
C * P * * * * * * * * * K E Y B O A R D * * * * *
R * P * * * * * * * * * * * * * * * * * * * * * *
T * Y * * * * * * * * * * * * * * * * * * * * * *
* * P R O G R A M * * * P R O M * * * * * * * * *
```



Mark comments that new matrices can be generated with the same list of words if the word list is reordered or the starting number of the random number generator is altered.

Holiday Inn-Part II is a program that helps in the *solution* of such puzzles, though the occasion may not often arise when you want to use a computer sledgehammer to swat the puzzle fly.

If you type the matrix of letters into the system, then type the words you know or think are embedded in the matrix, Holiday Inn-Part II will locate the words for you or deny their presence. Here's our PERSONAL COMPUTING puzzle once again, solved by the machine.

```
     1     5     9    13    17    21    25
 1   J P R O G R A M M Q A D Z W T R C Q W M P C D H F    1
 2   A H D X O F J U S K L I N G O N Y O M I P U K G R    2
 3   L C I T S I R U E H K E T Y B G T C R E K U Y I N    3
 4   A L I N I N D H N V G O H T N P A Z R K K T B T S    4
 5   S V O D P Y J D C T O B O R M D J S Z F V Y A T R    5
 6   V G A H D X S M Q Y E K N R U T O Z L R I Z C L K    6
 7   H H P H I Y O C D G Y Q N F K N F O R O F C N G Y    7
 8   V D P O G R V I E C N M P E A O P D N S M H O O E    8
 9   L Y L A I G U M K P R O M L L P M R D S U V B Q S    9
10   A G I H T B Q B D I N X F K Y F O Y V E A P S H M   10
11   R O C Y A N V S M Q A E J N C N L S Q C C Q N R D   11
12   E I A M L F C E C L E M O N A D E D I O T Q U Z Y   12
13   H X T X K E M C E L M P V I N V N D T R L P K H C   13
14   P H I M G W L L R I S Q N L M Q D W T P F N L X Z   14
15   I C O M I M S I Z R E M P Q T X O W E O P A Z W K   15
16   R U N X E M C A X X E R B G U B E D H R G Z E B N   16
17   E Z E X S Y I J I F K E Y B O A R D G C A Y C E R   17
18   P L G C O C S R I B Y V Y A E X S H A I G R P V Z   18
19   A X V E H A A N A N O S E C O N D H P M G P U V T   19
20   C A R B G S B Z S X V X L C H A M R S M C C P K O   20
21   K D V U Y E C D B E X J W X W X P Y F X D D K E Z   21
22   C O M P U T E R F Z N K S O F T W A R E U Q T S B   22
23   D I N T E R A C T I V E N X Y T B R F S O M Y N M   23
24   N G T A Y K C I Q O F S R P H L V X J R I T A U B   24
25   M X C O M P A T I B L E L O G I C E P W I Z W D X   25
     1     5     9    13    17    21    25
```

```
TURNKEY              6   16   HORZ
LEMONADE            12   10   HORZ
CRT                  1   17   HORZ
HEURISTIC            3   10   HORZ
NANOSECOND          19    8   HORZ
KLINGON              2   10   HORZ
PROGRAM              1    2   HORZ
APPLICATION          6    3   VERT
PERSONAL             2   21   DIAG
SPAGHETTI           20   19   VERT
SOFTWARE            22   13   HORZ
BASIC               20    7   VERT
ROBOT                5   14   HORZ
PERIPHERAL          18    1   VERT
COMPATIBLE          25    3   HORZ
PROM                 9   10   HORZ
BYTE                 3   15   HORZ
FLOPPY               5   20   DIAG
LOGIC               25   13   HORZ
KEYBOARD            17   11   HORZ
COMPUTER            22    1   HORZ
MICROPROCESSOR      19   20   VERT
DIGITAL              6    5   VERT
DEBUG               16   18   HORZ
INTERACTIVE         23    2   HORZ
MARK          NOT FOUND
JAMES         NOT FOUND
```

Mark could have cheated, of course. Since his computer created and stored the original puzzle, he might have called it from memory for this analysis instead of typing the whole matrix into the system, getting around the terrible task of transcribing and proofreading the matrix accurately. But he *didn't* cheat. Faithful drudge that he is, he suffered through the job on behalf of the eventual user. Such dedication!

Perhaps the Holiday Inn management will be moved by this to create meaningful matrices for distribution to their guests. Let's see . . . comfortable . . . mattresses . . . convenient . . . reservations . . .

Better than mortars, eh, Memphis?

Holiday Inn - Part I

```
FORTRAN IV G LEVEL  21                MAIN                DATE = 77109          16/12/59
 0001                 DIMENSION LET(25,25),IX(8),IY(8)
                      C
                      C
                      C
                      C       PROGRAM HOLIDAY INN-PART I WAS WRITTEN BY MARK JAMES
                      C       FOR THE COMEX PROJECT OF THE UNIVERSITY OF SOUTHERN CALIFORNIA
                      C       DATE-4/19/77
                      C       GIVEN A LIST OF WORDS, THE PROGRAM WILL ATTEMPT TO PLACE
                      C       THE WORDS IN A MATRIX RANDOMLY IN ONE OF EIGHT DIFFERENT
                      C       DIRECTIONS AND THEN RANDOMLY PLACE IN THE REMAINING SPACES
                      C       LETTERS OF THE ALPHABET. FOR OPTIMAL USE: PLACE LONGEST WORDS
                      C       IN LIST FIRST.
                      C
                      C
                      C
 0002                 DIMENSION ITEST(35,20),IALPHA(26)
                      C
                      C       LET=MATRIX OF LETTERS
                      C
                      C       IX=ROTATIONAL COORDINATES FOR X-VECTOR
                      C
                      C       IY=ROTATIONAL COORDINATES FOR Y-VECTOR
                      C
                      C       ITEST=WORDS TO BE LOCATED IN MATRIX-MAX 35 WORDS & 20 LETTERS/W
                      C
                      C       IQ=COUNTER FOR # OF WORDS READ IN
                      C
                      C       NUMB=COUNTS THE NUMBER OF LETTERS IN EACH WORD
```

Continued on p. 98

See Sol here...

ALABAMA

ICP, Computerland
1550 Montgomery Hwy.
Birmingham, AL 35226
(205) 979-0707

ARIZONA

Byte Shop Tempe
813 N. Scottsdale Rd.
Tempe, AZ 85281
(602) 894-1129

Byte Shop Phoenix
12654 N. 28th Dr.
Phoenix, AZ 85029
(602) 942-7300

Byte Shop Tucson
2612 E. Broadway
Tucson, AZ 85716
(602) 327-4579

CALIFORNIA

The Byte Shop
1514 University Ave.
Berkeley, CA 94703
(415) 845-6366

Byte Shop of Burbank
1812 W. Burbank Blvd.
Burbank, CA 91506
(213) 843-3633

Byte Shop Computer Store
6041 Greenback Lane
Citrus Heights, CA 95610
(916) 961-2983

Computer Center
1913 Harbor Blvd.
Costa Mesa, CA 92627
(714) 646-0221

Data Consultants, Inc.
2350 W. Shaw, Suite 114
Fresno, CA 93711
(209) 431-6461

Bits 'N Bytes
679 S. State College Blvd.
Fullerton, CA 92631
(714) 879-8386

The Byte Shop
16508 Hawthorne Blvd.
Lawndale, CA 90260
(213) 371-2421

Opamp/Computer
1033 N. Sycamore Ave.
Los Angeles, CA 90038
(213) 934-3566

Digital Deli
80 W. El Camino Real
Mountain View, CA 94040
(415) 961-2828

The Computer Mart
624 West Katella #10
Orange, CA 92667
(714) 633-1222

Byte Shop
496 South Lake Ave.
Pasadena, CA 91101
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of San Francisco
1093 Mission Street
San Francisco, CA 94103
(415) 431-0640

Byte Shop
321 Pacific Ave.
San Francisco, CA 94111
(415) 421-8686

The Computer Room
124H Blossom Hill Rd.
San Jose, CA 95123
(408) 226-8383

The Byte Shop
509 Francisco Blvd.
San Rafael, CA 94901
(415) 457-9311

The Byte Shop
3400 El Camino Real
Santa Clara, CA 95051
(408) 249-4221

Recreational Computer
Centers
1324 South Mary Ave.
Sunnyvale, CA 94087
(408) 735-7480

Byte Shop of Tarzana
18424 Ventura Blvd.
Tarzana, CA 91356
(213) 343-3919

Computer Components
5848 Sepulveda Blvd.
Van Nuys, CA 91411
(213) 786-7411

The Byte Shop
2989 North Main St.
Walnut Creek, CA 94596
(415) 933-6252

Byte Shop
14300 Beach Blvd.
Westminster, CA 92683
(714) 894-9131

COLORADO

Byte Shop
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Byte Shop
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Englewood, CO 80110
(303) 761-6232

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Sunny Computer Stores
University Shopping Center
1238A S. Dixie Hwy.
Coral Gables, FL 33146
(305) 661-6042

Delta Electronics
2000 U.S. Hwy. 441 East
Leesburg, FL 32748
(904) 357-4244

Byte Shop of Miami
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Miami, FL 33155
(305) 264-2983

Microcomputer
Systems Inc.
144 So. Dale Mabry Hwy.
Tampa, FL 33609
(813) 879-4301

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Atlanta, GA 30340
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Evanston, IL 60201
(312) 328-6800

Reeves Communications
1550 W. Court St.
Kankakee, IL 60901
(815) 937-4516

itty bitty machine co.
42 West Roosevelt
Lombard, IL 60148
(312) 620-5808

INDIANA

The Data Domain
406 So. College Ave.
Bloomington, IN 47401
(812) 334-3607

The Byte Shop
5947 East 82nd St.
Indianapolis, IN 46250
(317) 842-2983

The Data Domain
7027 N. Michigan Rd.
Indianapolis, IN 46268
(317) 251-3139

KENTUCKY

The Data Domain
3028 Hunsinger Lane
Louisville, KY 40220
(502) 456-5242

MICHIGAN

The Computer Store
of Ann Arbor
310 East Washington
Ann Arbor, MI 48104
(313) 995-7616

Computer Mart
of Royal Oak
1800 W. 14 Mile Rd.
Royal Oak, MI 48073
(313) 576-0900

General Computer Store
2011 Livernois
Troy, MI 48084
(313) 362-0022

MINNESOTA

Computer Depot, Inc.
3515 W. 70th St.
Minneapolis, MN 55435
(612) 927-5601

NEW JERSEY

Hoboken Computer Works
No. 20 Hudson Place
Hoboken, NJ 07030
(201) 420-1644

The Computer Mart
of New Jersey
501 Route 27
Iselin, NJ 08830
(201) 283-0600

NEW YORK

The Computer Mart
of Long Island
2072 Front Street
East Meadow, L.I. NY 11554
(516) 794-0510

The Computer Shoppe
444 Middle Country Rd.
Middle Island, NY 11953
(516) 732-4446

The Computer Mart
of New York
118 Madison Ave.
New York, NY 10001
(212) 686-7923

The Computer Corner
200 Hamilton Ave.
White Plains, NY 10601
(914) 949-3282

OHIO

Cybershop
1451 S. Hamilton Rd.
Columbus, OH 43227
(614) 239-8081

Computer Mart of Dayton
2665 S. Dixie Ave.
Dayton, OH 45409
(513) 296-1248

OREGON

Byte Shop Computer Store
3482 SW Cedar Hills Blvd.
Beaverton, OR 97005
(503) 644-2686

The Real Oregon
Computer Co.
205 West 10th Ave.
Eugene, OR 97401
(503) 484-1040

Byte Shop Computer Store
2033 SW 4th Ave.
Portland, OR 97201
(503) 223-3496

RHODE ISLAND

Computer Power, Inc.
M24 Airport Mall
1800 Post Rd.
Warwick, RI 02886
(401) 738-4477

SOUTH CAROLINA

Byte Shop
2018 Green Street
Columbia, SC 29205
(803) 771-7824

TENNESSEE

Microproducts & Systems
2307 E. Center St.
Kingsport, TN 37664
(615) 245-8081

TEXAS

Byte Shop
3211 Fondren
Houston, TX 77063
(713) 977-0664

Interactive Computers
7646½ Dashwood Rd.
Houston, TX 77036
(713) 772-5257

The Micro Store
634 So. Central
Expressway
Richardson, TX 75080
(214) 231-1096

VIRGINIA

The Computer Systems
Store
1984 Chain Bridge Rd.
McLean, VA 22101
(703) 821-8333

Media Reactions Inc.
11303 South Shore Dr.
Reston, VA 22090
(703) 471-9330

WASHINGTON

Byte Shop Computer Store
14701 N.E. 20th Ave.
Bellevue, WA 98007
(206) 746-0651

The Retail Computer Store
410 N.E. 72nd
Seattle, WA 98115
(206) 524-4101

WISCONSIN

Madison Computer Store
1910 Monroe St.
Madison, WI 53711
(608) 255-5552

The Milwaukee
Computer Store
6916 W. North Ave.
Milwaukee, WI 53213
(414) 259-9140

CANADA

Trintronics
160 Elgin St.
Place Bell Canada
Ottawa, Ontario K2P 2C4
(613) 236-7767

First Canadian
Computer Store Ltd.
44 Eglinton Ave. West
Toronto, Ontario M4R 1A1
(416) 482-8080

The Computer Place
186 Queen St. West
Toronto, Ontario M5V 1Z1
(416) 598-0262

Pacific Computer Store
4509-11 Rupert St.
Vancouver, B.C. V5R 2J4
(604) 438-3282

Processor Technology Corporation

"A mess of parts doth not a computer make"

ANON

Undoubtedly ANON was talking about some of today's PC computers. Exciting as they may be, most of them give you a few surprises you really don't need.

For example you have the board all wired, and suddenly it occurs to you, "Where's the TV interface?"

Surprise! (The TV interface is extra and costs $200 plus.)

"And the keyboard interface — where's that?"

Surprise! (Add another $185 extra.)

"How about an audio cassette interface so you can store and enter low cost programs and large amounts of data?"

Surprise! (Add $175 more.)

"And what about software?"

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See what we mean?

The new Sol PC Terminal Computer. It's a complete kit, hardware, software and no surprises for $475.

It's the first small computer conceived as part of a total system.

Not only do you get everything you need, but our systems approach is more economical, too. The $475 kit (fully assembled and tested, $745) includes all of the following as standard features:

Video display interface.
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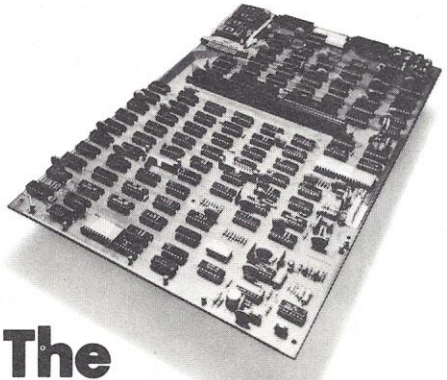


The Sol PC Terminal Computer

CIRCLE 37

Continued from p. 95

```
C
C       UNIST=FUNCTION SUBROUTINE WHICH INITITES THE RANDOM GENERATOR.
C            ONLY AVAILABLE AT USC.
C
C       UNI=FUNCTION SUBROUTINE WHICH GENERATES RANDOM DEVIATES (0-1)
C
C       JX,JY=STARTING COORDINATES FOR PLACING WORD IN MATRIX
C
C       IN=ROTATIONAL VECTOR-1 OF 8 DIRECTIONS WHICH WE CAN ROTATE
C          THE WORD
C
C
0003          DATA IALPHA/'A','B','C','D','E','F','G','H','I','J','K','L',
             1'M','N','O','P',       'Q','R','S','T','U','V','W','X','Y','Z'/
0004          DATA IBLNK/' '/
0005          DATA LET/625*'*'/
0006          DATA IX/0,3*-1,0,3*1/
0007          DATA IY/2*1,0,3*-1,0,1/
0008          DATA ISTAR/'*'/
0009          IQ=1
0010          CALL UNIST(75)
0011          WRITE(6,300)
0012     300  FORMAT('1')
0013     1    READ(5,101,END=99)(ITEST(IQ,I),I=1,20)
0014          NUMB=0
0015          DO 11 I=1,20
0016          IF(ITEST(IQ,I).EQ.IBLNK) GOTO 12
0017     11   NUMB=NUMB+1
0018     101  FORMAT(20A1)
0019       12 JX=UNI(0)*100.+.5

FORTRAN IV G LEVEL  21                  MAIN              DATE = 77109          16/12/59

0020          IF(JX.GT.25.OR.JX.LT.1) GO TO 12
0021     13   JY=UNI(0)*100.+.5
0022          IF(JY.GT.25.OR.JY.LT.1) GO TO 13
0023     74   IN=UNI(0)*10.+.5
0024          IF(IN .GT. 8 .OR. IN .LT.1)  GOTO 74
0025          I=IN
0026     70   LX=JX
0027          LY=JY
C
C
C       TEST TO SEE IF THE SPACE AVAILABLE OR IF THE SPACE HAS A
C       LETTER WHICH BEGINS WITH THE CURRENT WORD
C
C
C
0028          IF(LET(LX,LY).NE. ISTAR.AND. LET(LX,LY).NE. ITEST(IQ,1)) GO TO 12
0029          DO 80 J=2,NUMB
0030          LX=LX+IX(I)
0031          LY=LY+IY(I)
C
C
C       IF THE WORD CANNOT FIT IN THIS DIRECTION-TRY ANOTHER
C
C
0032          IF(LX.GT.25.OR.LX.LT.1)   GOTO 71
0033          IF(LY.GT.25.OR.LY.LT.1)   GOTO 71
0034          IF(LET(LX,LY).NE. ISTAR.AND. LET(LX,LY).NE. ITEST(IQ,J))GOTO71
0035     80    CONTINUE
C
C
C       IF WE GET TO HERE-THE WORD FITS-INSERT WORD AND READ IN NEXT 1
C
C
C
0036          LX=JX
0037          LY=JY
0038          LET(LX,LY)=ITEST(IQ,1)
0039          DO 81 J=2,NUMB
0040          LX=LX+IX(I)
0041          LY=LY+IY(I)
0042     81   LET(LX,LY)=ITEST(IQ,J)
0043          IQ=IQ+1
0044          GO TO 1
0045     71   I=I+1
C
C
C       IF I=IN WORD CANNOT FIT ANYWHERE-THEN FIND A NEW SET OF COORDS.
C
C
C
0046          IF(I.EQ.IN) GOTO12
0047          IF(I.GT.8) I=1
0048          GO TO 70
C
C
C       WRITE OUT MATRIX SHOWING LOCATIONS
C
C
0049     99   DO 10 I=1,25
```

```
FORTRAN IV G LEVEL  21                  MAIN                DATE = 77109          16/12/59

 0050          10    WRITE(6,200) (LET(I,J),J=1,25)
 0051          200   FORMAT('0',10X,25(A1,1X))
                     C
                     C
                     C        FILL IN REMAINING SPACES(*) WITH RANDOM LETTERS
                     C
                     C
                     C
 0052                      DO 60 I=1,25
 0053                      DO 60 J=1,25
 0054                      IF(LET(I,J)-ISTAR)60,59,60
 0055          59          IA=UNI(0)*100.+.5
 0056                      IF(IA.GT.26 .OR.IA.LT.1) GO TO 59
 0057          58          LET(I,J)=IALPHA(IA)
 0058          60          CONTINUE
 0059                      WRITE(6,300)
                     C
                     C
                     C        WRITE THE MATRIX OUT AGAIN
                     C
                     C
 0060                      DO 61 I=1,25
 0061          61          WRITE(6,200)(LET(I,J),J=1,25)
 0062                      WRITE(6,300)
                     C
                     C
                     C
                     C        WRITE OUT LIST OF WORDS TO BE FOUND
                     C
                     C
 0063                      IQ=IQ-1
 0064                      DO 90 I=1,IQ
 0065          90          WRITE(6,400)(ITEST(I,J),J=1,20)
 0066          400         FORMAT('0',5X,20A1)
 0067                      STOP
 0068                      END
```

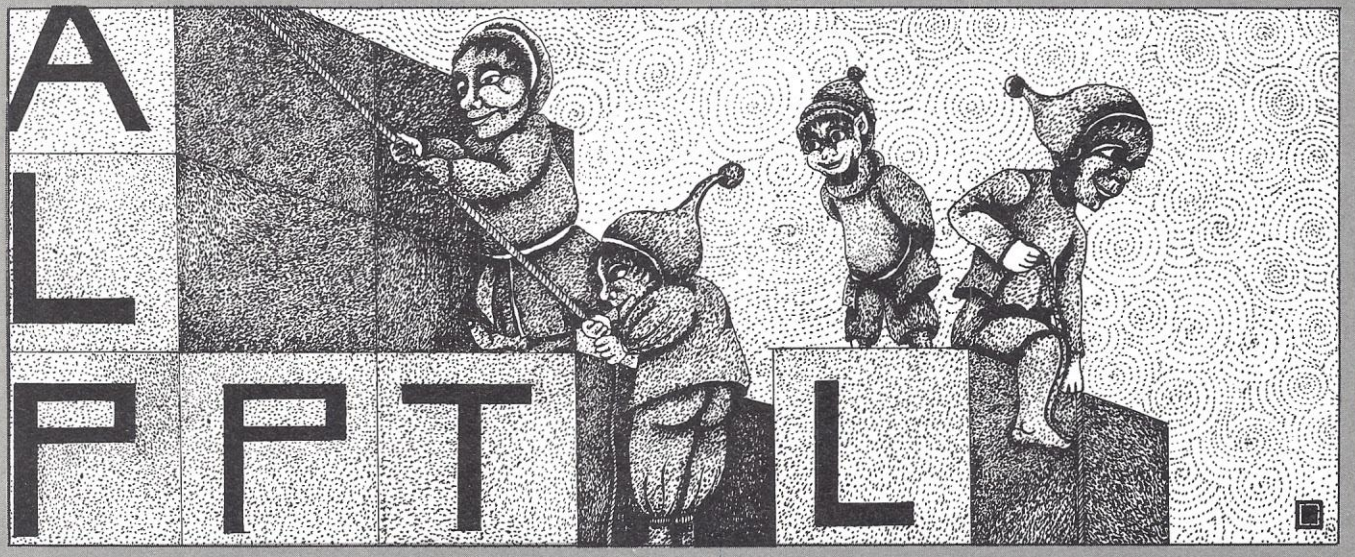
Holiday Inn - Part II

```
FORTRAN IV G LEVEL  21                  MAIN                DATE = 77115          15/22/34

 0001                DIMENSION LET(25,25),ITEST(20),WAY(8)
                     C
                     C
                     C
                     C        PROGRAM HOLIDAY INN-PART II WRITTEN BY MARK JAMES FOR THE
                     C        COMEX PROJECT OF THE UNIVERSITY OF SOUTHERN CALIFORNIA.
                     C        PROGRAM IF GIVEN A MATRIX WHICH CONTAINS HIDDEN WORDS
                     C        AND IF ALSO GIVEN A LIST OF THOSE WORDS WILL LOCATE THOSE
                     C        WORDS GIVING COORDINATES OF THE STARTING LETTER AND THE
                     C        DIRECTION IN WHICH TO CONTINUE FINDING THE REMAINING LETTERS
                     C        OF THAT WORD
                     C
                     C
                     C
 0002                DIMENSION IX(8),IY(8)
                     C
                     C
                     C
                     C        LET=MATRIX OF LETTERS
                     C
                     C        ITEST=LIST OF WORDS TO BE FOUND
                     C
                     C        WAY=DIRECTION WORD APPEARS
                     C
                     C        IX=ROTATIONAL COORDINATES FOR X-DIRECTION
                     C
                     C        IY=ROTATIONAL COORDINATES FOR Y-DIRECTION
                     C
                     C
                     C
 0003                DATA IBLNK/' '/
 0004                DATA WAY/'HORZ','DIAG','VERT','DIAG','HORZ','DIAG','VERT','DIAG'/
 0005                DATA IX/0,3*-1,0,3*1/
 0006                DATA IY/2*1,0,3*-1,0,1/
                     C
                     C
                     C        READ IN THE MATRIX
                     C
                     C
 0007                DO 10 I=1,25
 0008          10    READ(5,100)(LET(I,J),J=1,25  )
 0009          100   FORMAT(25A1)
 0010                WRITE(6,41)
 0011          41    FORMAT('1')
 0012                WRITE(6,300) (I,I=1,25,4)
 0013          300   FORMAT('0',19X,7(I2,6X))
                     C
                     C
                     C        WRITE OUT MATRIC
                     C
                     C
                     C
 0014                DO 42 I=1,25
 0015          42    WRITE(6,40)I,(LET(I,J),J=1,25),I
 0016                WRITE(6,300) (I,I=1,25,4)
 0017          40    FORMAT('0',15X,I2,3X,25(A1,1X),I4)
 0018                WRITE(6,41)
 0019          1     READ(5,101,END=99)ITEST
                     C
```

Continued on p. 100

Continued from p. 99

```
FORTRAN IV G LEVEL  21                MAIN              DATE = 77115          15/22/34
                      C
                      C         READ IN WORD TO BE FOUND
                      C
                      C
                      C
     0020             101      FORMAT(20A1)
     0021                      NUMB=0
                      C
                      C
                      C
                      C         COUNT # OF LETTERS IN WORD
                      C
                      C
                      C
     0022                      DO 11 I=1,20
     0023                      IF(ITEST(I).EQ. IBLNK) GO TO 12
     0024             11       NUMB=NUMB+1
     0025             12       DO 90 JX=1,25
     0026                      DO 90 JY=1,25
     0027                      DO 20 I=1,8
     0028                      LX=JX
     0029                      LY=JY
     0030                      IF(LET(LX,LY).NE. ITEST(1)) GO TO 90
                      C
                      C         LOCATE SAME LETTER AS FIRST LETTER OF WORD READ IN
                      C
                      C
                      C
     0031                      DO 30 J=2,NUMB
                      C
                      C
                      C         SEE IF REMAINING LETTERS CAN ALSO BE MATCHED
                      C
                      C         IF IT DOESN'T TRY TO ROTATE IN A DIFFERENT DIRECTION
                      C
                      C
                      C
     0032                      LX=LX+IX(I)
     0033                      LY=LY+IY(I)
     0034                      IF(LX.GT.25.OR.LX .LT.1) GOTO 20
     0035                      IF(LY.GT. 25.OR.LY.LT.1) GO TO 20
     0036                      IF(LET(LX,LY) .NE. ITEST(J)) GO TO 20
     0037             30       CONTINUE
     0038                      WRITE(6,200) ITEST,JX,JY,WAY(I)
     0039             200      FORMAT('0',20A1,5X,2I5,5X,A4)
     0040                      GO TO 1
                      C
                      C
                      C          READ IN NEXT WORD
                      C
                      C
     0041             20       CONTINUE
     0042             90       CONTINUE
     0043                      WRITE(6,201) ITEST
     0044             201      FORMAT('0',20A1,5X,'NOT FOUND')
     0045                      GOTO 1
                      C
                      C


FORTRAN IV G LEVEL  21                MAIN              DATE = 77115          15/22/34
                      C
                      C          READ IN NEXT WORD
                      C
                      C
                      C
     0046             99       STOP
     0047                      END
```



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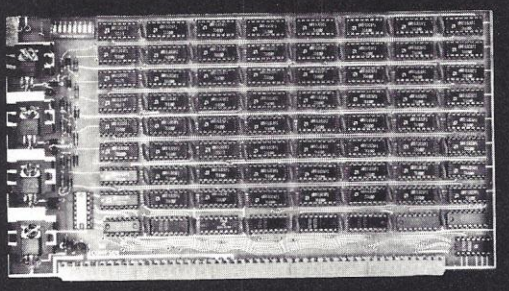

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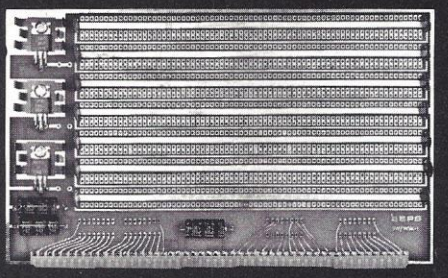

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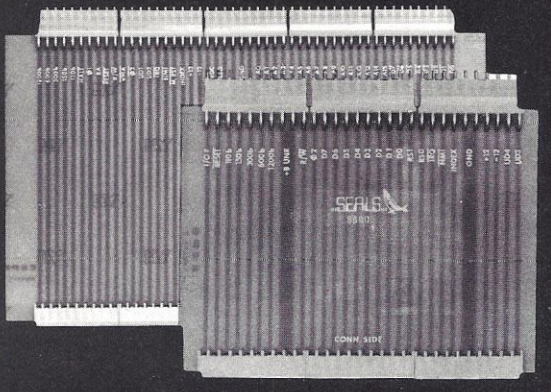

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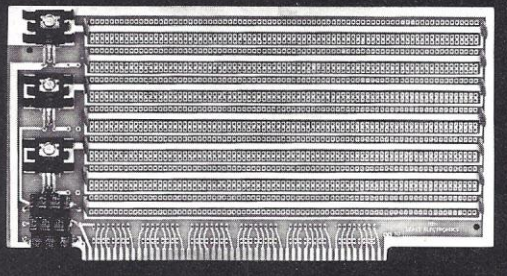

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CIRCLE 40


1985

FUTURE COMPUTING

Who will look after the Computing part of Personal Computing

by Fred Gruenberger

I guess it didn't astonish me to learn about high fidelity fans who assemble the absolute ultimate in quality equipment but seldom listen to music. I can comprehend the person who tinkers endlessly with high powered engines but does little driving. I can accept that the Wright brothers were not noted for being air travelers. I can even accept the fact that most ham radio operators, who are equipped for superb communication with distant parts of the globe, communicate only the quality of their transmission and never even inquire about the weather conditions in Marrakesh, or wherever they make contact.

But when the hobbyist computer fad struck us a couple of years ago, I fully expected that some of the 20,000 or so people who paid a lot of money and invested hundreds of hours in assembling a machine would then be somewhat interested in computing. I have yet to meet one.

What I have met is a lot of people (including students of mine) who are all bright-eyed and bushy-tailed about their new XYZ computer kit, which they are busy assembling. They all seem to want to impress me with the high ratio of gear acquired to dollars spent, and I *am* impressed because they are about to put together for nearly nothing what would have cost a fortune just a few years back. Being impressed, I inquire gently, "When you get it all assembled and tested, what will you do with it? Usually the answer is "I'll add another 100K bytes of storage, and a CRT display, and a disk drive." So I keep probing: "Yes, and *then* what will you do with it?"

And at this point they all go blank, as though I had raised a completely irrelevant question. They mumble vaguely about maybe writing a super compiler, or a chess playing program, or some such. They never, ever, mention any interest in computing anything.

The experts in the personal computing field ridicule my probing. They cite the example they know, of the person who has indexed his entire record collection on his home computer. (This task, it seems to me, is better served with 3 x 5 cards. I can't quite see the need for millisecond access to a record index. Besides, where is the *computing* in making or using that index?) Or, someone has plans to control every device in his home with his computer. (Again, substitute for a few cheap clock timers. And where is there any *computing* involved?) Each person will, of course, play lots of games with his machine, preferably preprogrammed Star Trek.

The question that I am raising depends, of course, on what someone thinks computing is, and opinions certainly differ. We have, for example, frequently published in *Popular Computing* what we thought were dandy computing problems, only to have them demolished by analytic means. That's fine; if a problem is most expeditiously handled by algebra or calculus, then it is not intelligent to use a computer to solve it. But the dividing line is awfully thin. It should be clear at least that problems that can be solved by staring at the ceiling for a few minutes are not good computer problems. The same ought to be true for problems that are best handled graphically, or with a set of file cards, or by using a punched card sorter.

Such problems are unsuited to computer attack at a low level. At the other extreme, a passable chess playing program is beyond the micro computer; chess is far too complex for miniature machines (not to mention novice programmers or novice chess players). But there are plenty of open-board games that could be attacked with some chance of success (Oware and Fives, for two examples).

I try to keep in mind that it's a free country; if anyone wants to work hard to build a machine whose only function will be to ripple bit patterns through storage, that's fine. But after that, it's time to start using the new gadget for its chief purpose, which is to compute.

The computer-building fad has probably run its course anyway. Fully assembled packaged machines are due out this year at attractive prices, and the days of the soldering iron and wire wrap tool are nearly over. Notice that not too long ago, hobbyists could buy a Heathkit to make a desk calculator, which was lots of fun. Just when many of those $100 kits were completed, their builders noticed that far better machines (factory assembled, tested, and guaranteed) were available at the corner drug store for $39, and Heath quietly dropped that item from their catalog. We are now at the same point with personal computers. Very few people will buy kits and do all the work when better machines are offered already built. The soldering iron fun will be missing, to be replaced by the much greater fun of using a computer.

Continued on next page

At first, this fun may take the form of game playing, but eventually (and quite soon) we will see personal machines by the hundreds of thousands, to be used to solve real problems. It is my contention that problem solving by computer will soon become a hobby of its own, and few of its practioners will care much about the internal circuitry of their machine, or even the details of its software, other than to insist that it function properly.

With factory-assembled full-blown computers soon to be available, there should be large numbers of users of personal computers who will have little else to do *but* compute. They will buy the machine for some mundane purpose, like the accounting functions for a small business, and find themselves with lots of computer time left over, at which point they can begin to explore more and more sophisticated problems. Fortunately, there is an unlimited stock of excellent problems waiting to be worked on. Just as an example, let me suggest my favorite.

Suppose there are three numbers, A, B and C, in storage and they are to be arranged in ascending order. The following scheme will do it:

1. Compare A to B; if A is less than or equal to B, do nothing; otherwise interchange A and B.
2. Similarly, compare B and C and interchange if necessary.
3. Similarly, compare A and B and interchange if necessary.

Let's express all this logic with this notation: AB BC AB. If, now, we have four numbers to sort, the logical extension of the above scheme is: AB BC CD AB BC AB. Many textbooks have stated that that *is* the proper algorithm; namely, *six* comparisons and interchanges to sort four numbers. The scheme does indeed work, but it can be done with only *five* comparisons and interchanges: AB CD AC BD BC.

So that brings us to the problem of sorting five numbers by direct internal sorting (as opposed to merge sorting, the Shell sorting algorithm or bubble sorting). We have arrived at this table:

Numbers to be sorted	Comparisons in theory	Comparisons actually needed
2	1	1
3	3	3
4	6	5
5	10	?

The extension of the usual theory tells us that the scheme for sorting five numbers should be: AB BC CD DE AB BC CD AB BC AB and that scheme will work. But since we know that, for four numbers only five comparisons and interchanges are needed, we know that for five numbers we will need less than ten (but more than five) comparisons. The possible number of comparisons is six, seven, eight or nine – and no one knows which. Except for trying all possible combinations (and the number of them is enormous), we don't even know how to go about it. Now, *that's* a computing problem. It is readily understood (that is, it is well defined); it involves only a few small numbers; and anyone could attack it, using simple equipment. Perhaps it could be done analytically, but no method is apparent. (Note: Sorting theory indicates that the number of comparisons needed to sort K things goes up be $\log_2 K$ so that the answer to the problem I've posed is 8. I'll accept that; what is left is determining just *what* 8 comparisons will do the job.)

There is an unending list of good problems to be worked on, in geometry, number theory, and combinatorial work. No one knows the number of ways a 12 x 12 checkerboard can be cut into four congruent pieces (following the lines of the board). No one knows how many square polyominoes of length 19 squares there are. Not much is known about the behavior of random processes. All of these problem situations are wide open for exploration by personal computer users.

Besides these vast areas of the unknown, there are also countless problems that *have* been solved, but solving them again (perhaps in new ways) provides insight into the computing art. Consider as an example one of the problems we used as a contest in *Popular Computing,* which got to be known as the Take/Skip problem: Start with all the positive natural numbers: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, . . . Take the first number; reject the second; take the third; and so on. This is stage 1, and it leaves us with the odd integers.

Out of the numbers remaining at stage 1, in stage 2 take two numbers; reject two; take two; and so on. We now have left: 1, 3, 9, 11, 17, 19, 25, 27, 33, 35, 41, . . .

This process is continued indefinitely. After stage 3 (take 3; reject 3; and so on) we would have left: 1, 3, 9, 25, 27, 33, 49, 51, 57, 73, 75, . . . and the Problem is: What numbers will survive all of the stages?

Several of us tried all sorts of approaches to this problem. As I recall, we wrote collectively some seven different programs, one of which (after several *hours* of running on a moderately fast machine) yeilded 42 numbers. The contest winners wrote a program that yielded (in some *minutes* of CPU time) 1200 numbers. It's a dandy problem to sharpen your computing wits on.

Very little is known about how to solve problems, and particularly how to solve computing problems. You can't reduce problem solving to a set of rules, any more than you could construct rules for writing great symphonies or plays. But we have observed this: those who are outstanding at problem solving have done a great deal of it. In the belief then that "The way to learn computing is to compute," the thing to do with a computer is find some problem area that you enjoy and plunge in and solve a lot of problems. Besides being fascinating, it's the way to learn the art. It is probably the only way.

When it comes to *computing,* there are four things to be learned:

What constitutes a computer problem. (As opposed to trivia, or problems done better by other means, or problem solutions that would take a lifetime of the largest and fastest machine in existence.)

How to solve a computer problem. (This includes not only all the subject's mechanics, but much of the same low cunning used to solve problems in any milieu.)

How to tell that you've computed correctly. (This is the tough one. The printed output from our machines always looks authentic, but it is a high form of art to gain some assurance that what you've computed is not garbage.)

What things are worth computing. (This topic is subjective and personal – no two people would agree on the criteria for worthwhileness. But each person should decide for himself on what he regards as worth doing.)

The whole game is fascinating and addictive, and the excitement of it can last for over 30 years. As a hobby, it will probably get more exciting as it builds up to a national craze.

We have already passed the cross-over point at which man/machine roles reverse themselves. Not too long ago, whether we liked it or not, people worked to serve the computers. In order to have any computing power at all, someone had to invest a million dollars or so. Then, to protect that investment,

elaborate mechanisms had to be set up to keep the machines occupied around the clock. The results were intended to serve people, to be sure, but a great many people spent all their time serving the machines.

Beginning in 1968 or so, this inverse symbiosis began to undergo remission, and the new trend has accelerated rapidly since 1975. Computing power has become so cheap and so portable that it is now clear that we can bring the machine to the problem (which is as good a definition of a mini computer as you're going to get) and, in the extreme, bring the machine to the individual; that is, personal computing. A natural consequence of this trend (and one that is difficult for many old-timers to grasp) is that a lot of equipment is going to be idle much of the time; this is precisely the price we pay for convenience.

At the same time that computers are becoming available (in price and physical size) to fit the problems, calculators (which are a different breed of cat) are also becoming cheap and powerful. I do not believe that these lines of machines are going to cross. Programmable calculators will continue to get more powerful, but will still offer decimal programming and built-in functions (e.g., logarithms, trig functions, and statistical functions).

Each individual user will decide for himself whether to acquire a computer or a high powered calculator (but notice that a computer can be readily programmed to duplicate any of the actions of a calculator). Either way, it's clear that this country is going to be flooded with personal computing devices of ever-increasing power. The bulk of them will become dedicated to one or two quite mundane tasks, but for some the wonderful world of problem solving with computers will suddenly open up.

There will really be only one small problem left: whatever machine one buys, there will always be the nagging fact that if you had only waited one more month. . . ■

Fred Gruenberger began work in machine computation – in 1943, and began teaching computing in 1949. He has published much material on computing: 26 books, 14 films and most of the contents of two magazines (COMPUTING NEWS from 1953 to 1957, and POPULAR COMPUTING from 1973 to date), as well as numerous articles in trade journals. Following eleven years of work in industry, he joined California State University, Northridge in 1966, where he is currently a professor of Computer Science.

A new convert is the most aggressive zealot in any cause, they say. Consider the case of this advertising man, a wordsmith, who spent several decades in happy ignorance of computers, then was dragged to a Personal Computing show by his-son-the-programmer. Within weeks, he was grinding out tutorial letters bristling with programs and jolly computer talk. Beware! It could happen to you

THE ELECTRONIC TAR BABY

by Timothy Purinton

MAY 27, 1977

Dear Dan -

Yesterday, while your mother was giving a friend from Italy a conducted tour of the Getty Museum, I hiked over to Computer Power and Light (Compal), and attacked one of Gene Murrow's neat little machines. I've been there several times since you dragged me down to the PERSONAL COMPUTING show at the Hyatt. And of course you left me the first two issues of the magazine. I have to suppose you hoped that ol' Charlie Butterfingers might at last begin to understand just what you do for a living. Well, get this: I sat down and wrote -

```
1 PRINT "THIS IS A RECIPE FOR SPAGHETTI."
2 PRINT "THE ASSUMPTION HERE IS THAT AN"
3 PRINT "APPROPRIATE PORTION FOR ONE PERSON"
4 PRINT "WOULD BE A QUARTER-POUND OF CHEESE,"
5 PRINT "A HALF-PINT OF TOMATO SAUCE,"
6 PRINT "AND 6.4 OZ. OF SPAGHETTI, I.E. PASTA."
7 PRINT "NOW THEN -"
10 INPUT "HOW MANY GUESTS YOU GOT"; G
20 LET C=G*.25
30 LET S=G*.5
40 LET P=G*.4
```

I cheated. I used my calculator to figure out in advance that 4/10 pound of spaghetti would be 6.4 ounces. I wanted to express my "assumption" in ounces, for some reason, and my requirements in pounds without some complicated conversion in the program.

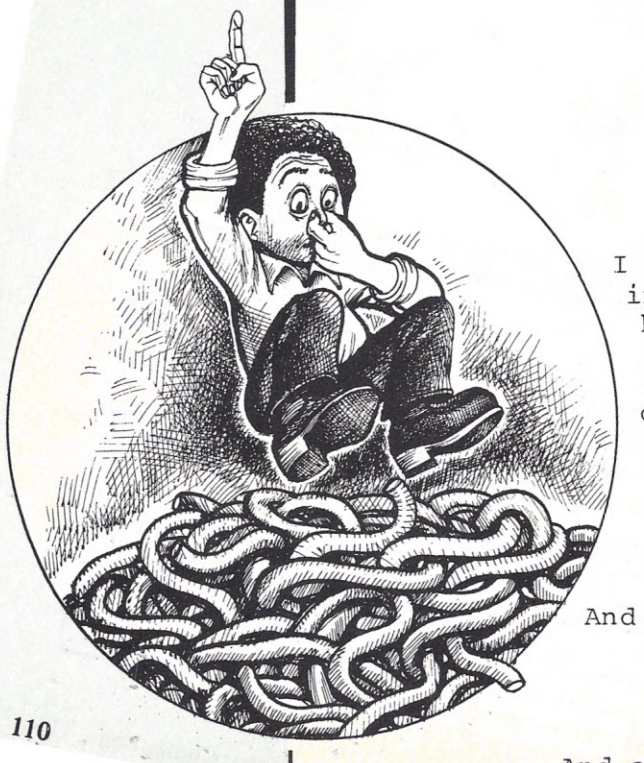
```
50 PRINT"FOR ";G " GUESTS YOU'LL NEED"
51 PRINT; C " POUNDS OF PARMESAN,"
60 PRINT; S " PINTS OF TOMATO SAUCE,"
70 PRINT "AND "; P " POUNDS OF SPAGHETTI."
80 PRINT "BETTER STOP AT THE STORE."
90 PRINT "BON APPETIT!"
```

And it ran like a bandit.

So then I modified it -

```
10 READ G
75 GOTO 10
100 DATA 12, 20, 750, 3259
```

And again it ran like a bandit until it said



something like -

```
     OUT OF DATA AT 10
```

and quit, without even an END to stop it.

This was the assignment, of course, laid on us by David Bunnell in the second issue of PERSONAL COMPUTING - his lessons called Spaghetti Basic. (The third is late.)

Stumbling around in the dark, I'm now trying to write a program that will tell me how many months will be required to amortize a debt, given a fixed number of dollars paid each month for Prin+Int, with interest charged on the declining balance - a little more complex than the interest program in Bunnell's first two lessons.

Why "stumbling around in the dark," you ask? Well now, Cobol Kid, we don't all learn programming in college. You'll recall how I got stuck with this Tar Baby.

When we were at that PC show, you were off looking at modems or something and I stood in the middle of Compal's big spread as Bearded John shelled out beginner's Basic to a packed house. When I picked up on him, John was just wrapping up an exercise in Calculating Golf Handicaps, and moving on into Friendly Conversations or How to Get Your Computer to Call You By Name. I paid attention because that seemed like fun, but all the consoles there were manned so I didn't get my hands on one until I circled over to the store itself about a week later.

Compal in Studio City is a tidy piece of wall-to-wall quiet with four or five machines kept juiced and alert. I explained that I wasn't really a prospect for buying anything or taking lessons, but just that I enjoy puzzles and word-games blah blah. . . So boss Gene Murrow made me welcome, sat me at a machine, loaded Hamurabi for me and stood off to let me starve my people in about two years. So we SCR'd that. He loaded Basic and I tried a little-

```
     1 PRINT "HELLO,THERE! I'M A COMPUTER."
     2 INPUT "WHO ARE YOU?" A$
     3 PRINT "OKAY, A$, NICE TO KNOW YOU."
```

And of course I couldn't wait to say -

```
     RUN
```

My new mechanical buddy immediately said -

```
     HELLO, THERE! I'M A COMPUTER.

     SYNTAX ERROR AT 2
     READY
     2
```

and stared at me.

I sat there with egg on my face and Gene noticed from across the room. He floated to us and read the CRT and told me gently that I needed ; - so I rewrote -

```
     2 INPUT "WHO ARE YOU?"; A$
     RUN
```

And my buddy said -

```
     HELLO, THERE! I'M A COMPUTER. WHO ARE YOU??
          NORBERT WIENER I told him.
     OKAY, A$, NICE TO KNOW YOU.
```

Wasn't fooled for a second.

Gene noticed me sitting there rebuffed. He floated back, looked at the CRT and told me about the quotes. So I rewrote -

```
     3 PRINT "OKAY," A$, "NICE TO KNOW YOU."
     RUN
```

And my faithful little nuts&bolts willingly hurried back to the top -

```
     HELLO, THERE! I'M A COMPUTER. WHO ARE YOU??
          WERNER VON BRAUN I lied.
     OKAY, WERNER VON BRAUN NICE TO KNOW YOU.
```

Gene smiled. "That's about right," he said, and stepped away, leaving me to get my jollies.

Well, that day I hung in there playing this kindergarten game and trying to improve my spacing. It was like trying to hold an extended conversation in French when all you know of the language is -

```
     1 PRINT "OU EST LA PLUME DE MA TANTE?"
     2 INPUT "LA PLUME DE MA TANTE EST -"; A$
```

```
     3 IF A$="SUR LA TABLE" THEN GOTO HEAD OF CLASS
     4 PRINT "WRONG, STUPID."
     5 END
```

By the time I stood up, aching in the gluteus maximus,Gene had to unlock the front door to let me out - I had outlasted his public day - and the parking meter had long since forgotten that I had ever fed it.

Limited and ignorant though I was, I had to go back. Several times. How much could that beast be expected to remember? If I gave it a meaning for A$, would it also be able to handle B$ and C$ and D$ etc.? Could it handle a multiple-choice setup on IF-THEN? At home, on this very typewriter, I hoked up exercises -

```
     1 INPUT "NAME A CAT -"; A$
     2 INPUT "AND A DOG -"; B$
     3 INPUT "AND A GIRAFFE -"; C$
     4 PRINT "NOW LET'S SEE IF I'VE GOT THAT STRAIGHT -"
     5 PRINT "THE CAT IS " A$ ", THE GIRAFFE IS " C$ ","
     6 PRINT "AND THE DOG IS " B$ "."
     7 INPUT "RIGHT -";D$
     8 IF D$="YES" THEN GOTO 20
     9 IF D$="NO" THEN GOTO 30
     10 PRINT "STICK TO YES OR NO, PLEASE. AGAIN -"
     11 GOTO 7
     20 PRINT "OF COURSE. YOU THINK I'M DUMB?
     21 PRINT "'BYE NOW!'"
     22 END
     30 PRINT "OOPS!"
     31 END
```

Or then again -

```
     1 PRINT "THERE WAS A YOUNG LADY FROM NOME"
     2 INPUT "WHO HAD A STRANGE HOLE IN HER -";A$
     3 IF A$="LOAM" THEN GOTO 20
     4 IF A$="HOME" THEN GOTO 30
     5 IF A$="DOME" THEN GOTO 40
     6 PRINT "YOU'RE OFF TARGET, BUDDY. LET ME HELP-"
     7 GOTO 50
     20 PRINT "NOT THAT, DIGGER. TURN IT OVER -"
     21 GOTO 2
     30 PRINT "WELL, MAYBE THAT"S POSSIBLE, BUT IT'S"
     31 PRINT "SOME OTHER LIMERICK. LET ME HELP YOU -"
     32 GOTO 50
     40 PRINT "YOU'VE GOT IT! THE LINE IS -"
     50 PRINT "WHO HAD A STRANGE HOLE IN HER DOME."
     51 PRINT "SHE SAID, IF I TRIED"
     52 PRINT "I COULD PROBABLY HIDE"
     53 INPUT "THE PERISHING THING WITH MY -"; B$
     54 IF B$="TOME" THEN GOTO 70
     55 IF B$="FOAM" THEN GOTO 80
     56 IF B$="COMB" THEN GOTO 90
     57 PRINT "YOU'RE IN REAL TROUBLE, FELLA. IT'S -"
     58 GOTO 91
     70 PRINT "WHAT IS SHE, A LIBRARIAN? NO NO, AGAIN -"
     71 INPUT "THE PERISHING THING WITH MY -";B$
     72 IF B$="COMB" GOTO 90
     73 PRINT "FORGET IT. I'LL GIVE YOU THE ANSWER -"
     74 GOTO 91
     80 PRINT "WHO SAID SHE'S A FIREMAN? OR IS THAT"
     81 PRINT "SOMETHING PHARMACOLOGICAL? ONE MORE TIME -"
     82 INPUT "THE PERISHING THING WITH MY -"; B$
     83 IF B$="COMB" GOTO 90
     84 PRINT "WHADDAYA, SOME KIND OF NUT? READ THIS -"
     85 GOTO 91
     90 PRINT "CONGRATULATIONS, MR. LONGFELLOW. IT READS -"
     91 PRINT "THERE WAS A YOUNG LADY FROM NOME,"
     92 PRINT "WHO HAD A STRANGE HOLE IN HER DOME."
```

```
93 PRINT "SHE SAID, IF I TRIED"
94 PRINT "I COULD PROBABLY HIDE"
95 PRINT "THE PERISHING THING WITH MY COMB."
96 PRINT "THE END. (CURTSY OR BOW FROM THE WAIST)""
```

The trouble with this sort of nonsense was that I was working all by myself - well, with Mr. Nuts&Bolts. Both of us knew how this exercise came out so there was no Gene or Susan or staff or passing strangers to sit in and try my dopey program. (I did once leave a message on the CRT: PLEASE RUN ONCE BEFORE SCR . . . and shyly slunk away.)

Of course I was making a conscious effort not to ask for help any more than I absolutely had to. Trial and Error, man, that was my route.

But then finally a couple of days ago I picked up PERSONAL COMPUTING again. I'd browsed through both issues and read a lot of stuff for information and entertainment, but I hadn't - obviously - done much about letting it *educate* me. I had read the Russ Walter stuff about what's wrong with Basic and it didn't mean diddlypoo, except to tell me he's some kind of Young Turk who declares publicly that his old teacher is a fuddyduddy. And I enjoyed Waldo and other robot-talk and the interview with Parker on computer knavery . . . There's a whole lot to absorb happily if you *never* build a little program or play a little game. And now the Tar Baby was getting me firmly stuck.

So there, suddenly, was Bunnell on Spaghetti Basic, telling me things I *knew* I needed to know to extend my range: *math*! Numbers, by gosh!! I *thought* computers had something to do with numbers, and I was *missing* all that. I had missed Bearded John on Golf Handicapping, but Bunnell knew about that stuff, too. I studied eagerly.

Well, I've already told you. I made a quantum leap into the spaghetti. Now I'm trying to shape up a way of reckoning interest on declining balance. I've absorbed what PC tells me about READ X and DATA. And as my Spaghetti Recipe shows, I know that the Compal Buddy thinks * is a multiplication sign. Does it think + is plus, and - minus, and / divided-by? I'll assume it does. Maybe -

```
10 INPUT "WHAT'S THE PRINCIPAL -"; PR
20 INPUT "WHAT'S THE INTEREST RATE -"; I
30 INPUT "WHAT'S THE MONTHLY PAYMENT -"; P
40 LET CI=PR*I/12 (figures the current month's int.)
50 LET B=PR-P+CI (balance after payment to prin&int)
60 GOTO 99
70 READ B (new balance to be figured on)
80 LET CI=B*I/12 (same routine, but with new balance)
90 LET B=B-P+CI  (another new balance)
99 PRINT "BALANCE IS$"; B   (lets me read it)
100 PRINT "DATA";B (updates the calculation)
110 GOTO 70   (where the new routine starts)
```

And maybe I'd have to say -

```
105 IF B  =0 THEN GOTO 120
```

to keep the machine from running to a negative infinity. I'd give it -

```
120 END
```

As you see, I'm trying to make the machine write its own DATA. I'm afraid you'll tell me it will never fly . . . that it's garbage. I'm sure you'll tell me or the machine will tell me that when DATA at line 100 gets printed out as a literal string, it's not an instruction, it's not in the LIST and the computer won't be able to find anything to refer to off of 35 READ B. I wish I could go over to the store and see, but it's midnight now and the doors are locked. Maybe if I took a brick and a flashlight . . . but could I manage to turn on a machine? It's Memorial Day weekend, for heavens sake. Gene won't be open till *Tuesday*! How am I going to survive until Tuesday?

I wish I'd never touched this Tar Baby.

* * *

May 28 '77

Last night I lay swiveling in the sack, trying to shape up the program for that crummy declining-balance problem and hating Bunnell for being late with the third lesson. It's practically June already . . .

It's ridiculously easy, I told me. Duck soup. I can do it on my calculator. It takes awhile, but I just have to knock off one month at a time -

Balance times (interest rate divided by twelve)
equals current month's interest
Payment minus current month's interest
equals amount by which balance is amortized
So Balance minus that amortization
equals the new balance after that payment
And that takes care of one month.
So suppose -

```
1 PRINT "ROUTINE FOR CALCULATING INTEREST"
2 PRINT "ON A DECLINING BALANCE"
3 PRINT "WITH UNIFORM MONTHLY PAYMENTS"
10 INPUT "WHAT'S THE BALANCE TO BEGIN WITH"; B
20 INPUT "WHAT'S THE UNIFORM MONTHLY PAYMENT"; P
30 INPUT "WHAT'S THE ANNUAL INTEREST RATE"; I
```

Wait a minute.

I've slipped into calling the original principal the "balance," which it is, of course. So I come to -

```
40 LET CI=B*I/12
50 LET B=B-P+CI
```

without ever mentioning a PR. And - "B=B-P+CI"?

That's the same impossible self-contradictory statement I made at 90 last time I drafted this thing. But I don't really mean that B is smaller than itself. That's just a way of saying I get a new value for B after a payment is made. I made the statement *let* B=etc. (let's pretend and agree for calculating purposes, that B= something impossible). The LET gives me a little sophistical crutch to let me hobble away from algebraic logic. I know already that in the Basic I'm using, the LET here is optional. I could come out flat-footed and say B=B-P+CI. WOW! IS THAT PART OF WHAT IT'S ALL ABOUT? Is that what this artificial semi-intelligence thing is for? Is it what you've been hoping I'd finally understand? *The machine is fed a figure; it massages the figure and produces a new figure; and having a new figure, it massages THAT one.* Is this IT?

It's 3:00 a.m. Saturday and I'm up fussing with a silly little program. Maybe I should keep track of the amount of the amortization -

```
60 LET A=P-CI
```

And I'll want to read the answers -

```
70 PRINT "OF THIS $"; P "PAYMENT,"
71 PRINT "AMORTIZATION CAME TO $"; A
80 PRINT "$"; CI " PAID CURRENT MONTH'S INTEREST"
90 PRINT "SO REMAINING BALANCE NOW IS $";B
100 IF B  =0 THEN GOTO 110
105 GOTO 40
110 END
```

I studied it. It looked solid to me. It ought to run. B=B-P+CI, eh? Heh-heh-heh. Gotcha.

I went back to bed and lay there thinking.

* * *

But if it does run and keeps looping that loop, it will zip the balance down to zero or slightly less so fast I won't be able to read it. With my READ-DATA version of the spaghetti recipe, I never really saw much until things screeched to a stop at OUT OF DATA. The CRT carries only some 16 lines and the calculations really hustle by. It's like trying to read thumbprints on a roller towel flying upward at 90

miles an hour. (I haven't been using Gene's hardcopy gear. He never made me feel like an intruder, but I know I am and I try to keep a low profile.) So how do I get to read? Well, maybe I could kill the 105 instruction, let the run stop and try to step the program through by hand. Maybe it would accept a hand-entered GOTO 40 and spell things out for me one month at a time. I could make notes and count the months . . . For the one practical problem I have in mind, the principal is $2775, the rate 10% and the monthly payment $200. What I'd really like to know most is how many months till it's paid off. I shouldn't have to count the months myself. Dang it, surely the computer could do that month-counting job!

I was wide-eyed, staring into the dark.

So one more time I got up and came to examine my latest shot at a program.

Hmm. If I can stomach B=B-P+CI, why can't I stick in a month-number -

```
35 LET M=1
```

That's the first month. I can modify 70 -

```
70 PRINT "AFTER "; M "MONTHS OF THIS $"; P " PAYMENT"
```

and then I can change the month-number just as I change the balance -

```
101 LET M=M+1
```

Have I rediscovered gravity? Reinvented the wheel? It's early Saturday. Gene won't be open for off-the-street business until noon Tuesday. Can I survive?

* * *

May 31 '77

At a quarter of twelve today, I was pacing in front of the store. Gene noticed me and hauled me in. I sat down with my notes, a red ballpoint and both issues of PERSONAL COMPUTING open to Bunnell's lessons. I fed the machine very carefully -

```
1 PRINT "A CALCULATION OF INTEREST ON A"
2 PRINT "DECLINING BALANCE, GIVEN"
3 PRINT "UNIFORM MONTHLY PAYMENTS"
10 READ B, P, I
40 CI=B*I/12
50 A=P-CI
60 B=B-A
70 PRINT "AFTER "; M " MONTHS OF THIS $"; P " PAYMENT"
```

Woops. Forgot my fancy new month-designator. Well, I can slip it in right here.

```
35 M=1
71 PRINT "$"; A " WAS APPLIED TO AMORTIZATION"
80 PRINT "AND $"; CI " PAID CURRENT INTEREST"
90 PRINT "SO REMAINING BALANCE NOW IS $"; B
100 IF B  =0 THEN GOTO 110
101 M=M+1
105 GOTO 40
109 DATA 2775, 200, .10
110 END
```

You know what happened. Seattle Slew should run so great. I don't care if Dave Bunnell ever delivers another lesson. I just may volunteer to write it for him.

By the way, after 15 months B=-$38.63.

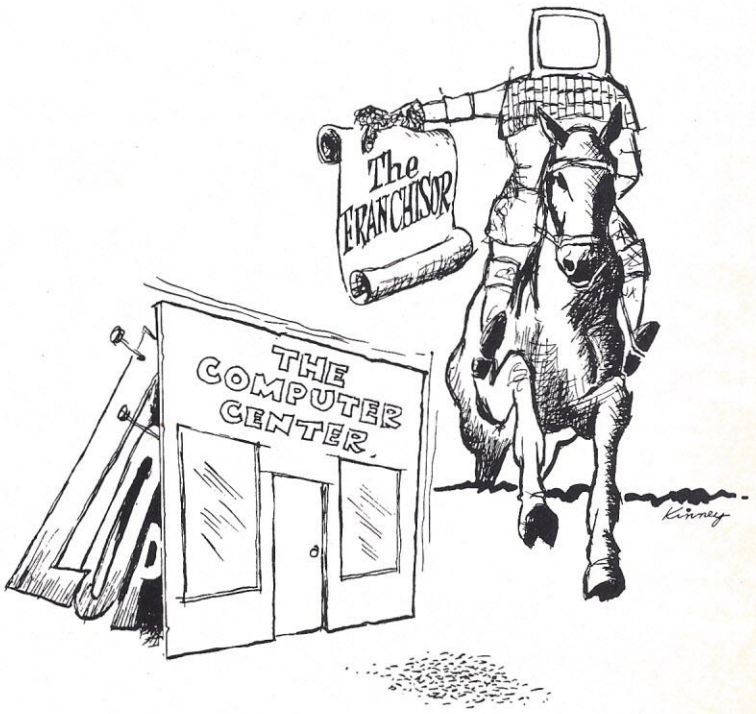
Keep in touch -

Part II

LOOK OUT FOR LOP

By Paul Conover
Consumer Computer Marketing, Inc.

In the first article of this series, the would-be computer retailer was invited to examine the pitfalls, as well as the attractions, of selling computers to his neighbors. The LOP (Lack Of Planning) Factor was highlighted as the most consistently lethal hazard to the cheerful entrepreneur. In this second article, Conover examines franchising as a potential solution to – or intensifier of – LOP.



Basically, all franchises offer the same things. In exchange for a franchise fee and some continuing amount of royalty, you'll get the limited use of a "franchise name" and service mark, access to proprietary products and service (if offered), training in the business operations and products, start-up help, advertising and continuing support and management assistance. Products and sales aids are available from the franchisors as well, though some states prohibit the franchisor from forcing you to buy your goods solely from it if comparable goods are available at competitive prices.

When you're evaluating a franchise offer you want to know about four main categories of information. 1) How much does it really cost? 2) What do I really get? 3) Who is the franchisor? and 4) What are the risks?

In the first category, Cost, you want to know at least these things: What is the total price? Does it include site location, accounting, pre-paid rent, fixtures, inventory, equipment and training? What other initial requirements are there? You'd better get a complete disclosure of all of this in writing. Also, you want to know what, if any, credit terms are there for the purchase of inventory? What advertising and sales aids are available? What do they cost? How do you pay for them? Who pays the shipping or freight charges on products? Are these pre-paid by the franchisor and billed to you? Does the carrier bill you?

What is the range of working capital required? How much money does it take to keep the doors open? The initial investment in a franchise for your outlet, training, promotion and other assistance is only the barest beginning. How are you going to pay the rent, utilities, payroll, insurance and three dozen other expenses if you don't sell anything your first three or six months in business? If you don't have this working capital in cash, ready to spend when it needs to be spent, you've got to close your doors.

As a cross check on this first area you might make a list of all the ways that a franchisor derives income from the franchisee. A list like this will help guide your questioning of the franchisor.

The second area of investigation is what do you get for your money. Do you own the franchise 100%? How long is the term of the agreement? Does the Return On Investment (ROI) ratio fit well with the term of the contract? How much tangible inventory, supplies, equipment, fixtures and the like are included in the franchise fee? How does the cost of these from the franchisor compare with competitive suppliers of the same goods? What portion of your fee goes to intangibles, services and assistance? Find out specificially how these are allocated. Get it in writing. When do these intangibles start being delivered? Are they mandatory? What are they worth? Could you do the same thing for less money on your own? The theory is that because the franchisor is doing these services for for many franchisees, there are economies that the franchisor enjoys that wouldn't ordinarily be available to a single franchisee. Is that true for what you're being offered? Get a complete list, in writing, with the declared cost of same from the franchisor and then independently figure what it would cost to do it for yourself. That could be an eye-opening exercise.

Thirdly, who is the franchisor? Who is involved and are they competent to do the job? These are the people that you're going to be "in bed" with for the next several years and your financial future is closely tied to their abilities to do what they say they will. How long has the franchisor been in business? How many of the franchises have failed or surrendered their franchise? Get a list of references and check these out carefully. A phone call is okay for references a long distance away from you, but be sure to confirm your conversation in writing and try to get a written reply to that letter. Sometimes a verbal okay will not be confirmed in writing.

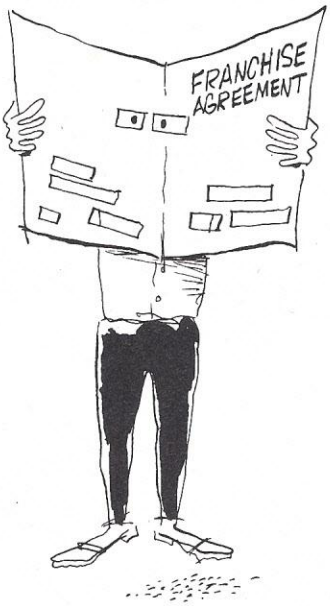
Keep in mind though, that store owners are in the business of selling computers, not computer stores. The time they choose to spend with any prospective out-of-town entrepreneurs takes away from their own business efforts. Respect their help and graciousness; don't assume it's their duty.

One store owner received a call from a fellow who declared that he was coming to town to see his operation on such-and-such a date. The store owner told him fine, come on in and look around. On the named date, the store owner received another call from the fellow who was more than a little put-out that the store owner hadn't been at the airport to meet him and drive him to the store. The store owner was astonished and told the fellow that he didn't have time to pick him up; he was busy running his business. The visitor lambasted him for ten minutes about courtesy and then hung up with the vague threat that the "home office" would learn about this effrontery. Apparently the fellow caught the next plane back to his home town, 1,100 miles away, never having seen the store. Sounds crazy? It's true, so help me CPU.

The message is clear – remember that owners are businessmen, not inexpensive consultants available at your beck and call.

In several states the franchisor must make a complete disclosure to the State's Corporation or Securities commissioner before even advertising in the state. Part of this registration requires that an "offering circular" or prospectus, plus a copy of any franchise or license agreement be sent to the prospective franchisee at least 48 hours before any money changes hands or documents are signed. This includes "good faith" deposits. If the state you're in doesn't require this sort of disclosure, you should ask for the offering circular anyway. The offering circular is a complete disclosure in plain language of all of the terms and conditions of the offering; who's who in the company; the financial statements of the company; the operating goals of the company. If the copy you receive has any missing information, question those "blanks" very closely.

Finally we come to risk. What are the risks? Well, if you've satisfied yourself that you have all the straight scoop up to this point and all the above questions have been fully answered, it's time to review the deal from a different perspective. What does all of this mean



from a pure business standpoint? Get out your list of questions and answers again. What are *you* risking? Is it worth it? Why? What does the franchisor risk? Is that a material risk? How do you really protect your territory? Actually, if you think you've found a fool-proof way to do so, you've overlooked something. What provisions do you have for commissions on sales made by the franchisor directly into your area? Can the franchisor do this? Are you required to make certain sales quotas or purchases from the franchisor to maintain your "exclusivity"? Are these realistic? Are you sure? Why? What happens if some of your inventory becomes obsolete while on the shelf? Will the franchisor take it back? What about defectives? How many franchises are being sold in your area? By the franchisor? By others? This is important if there are going to be several (ten or more) outlets within fifty miles selling microcomputers. Even though all stores may be selling roughly the same gear, what will make people come to your store instead of another? Can you be outgunned by a better businessman nearby with the same franchise? You can count on it.

From a regulatory point of view, federal laws make it impossible for a franchisee to have a completely protected territory. It's restraint of trade. If a franchisee of one company in St. Louis makes a sale to a Denver customer, where another franchisee of the same company is located, the franchisor cannot prohibit this nor can the St. Louis operation be compelled to pay any consideration to the Denver outlet. The law says that you can sell your products wherever you have a customer. Of course, you can't open a satellite office in someone else's "territory" if you're a franchisee. This is common to all franchise agreements. You receive the same protection from another franchisee of the same company too. As a rule, tie-in sales, territory/sales restrictions and similar constraints invite anti-trust problems and the franchisors are careful to stay away from them.

Some other things to think about: What happens if the franchisor folds up? Could you recoup your investment? What if you liquidate? Will you be required to continue your business if the franchisor blows away? What about renewal of the agreement? How much does it cost? Is that fair? If you're providing a good sales outlet for the company, obviously contributing to its profits and well-being, should you pay for the right to continue to do this for them? How about cancellation? Resale? What happens if you're a proprietorship and you die? Who are the suppliers of product for your outlet? Are they reliable? How well are the products received by consumers? Who are the competitors? Will you be featuring a product that isn't competitive because of price/performance? How financially strong are the suppliers? This is a lot to think about.

If this is beginning to sound like too much leg-work to do just to get informed, give up the idea of going into business. This ain't nothing yet. Wait 'til you open the store. Eighteen hours a day, seven days a week for a year or two are not unreasonable beginning parameters for a start-up situation, franchised or independent.

Have you got all of this so far? Are there any blank spots? Well, now its time to look briefly at the franchisors who are offering "easy ways" to get

in on the "ground floor" of this "explosive" and "fun" business.

Three companies now offer franchise packages. Each has some degree of qualification to do this and each is registered at least with the State of California. There's Byte Shop (Byte Inc.), Altair Computer Center (MITS, Inc.) and Computerland, Inc. (formerly Computer Shack Inc.) Each offer the would-be businessman a "turn-key" package described above, has established its "name" to a certain degree and brings to the industry different track records of success in the microcomputer market.

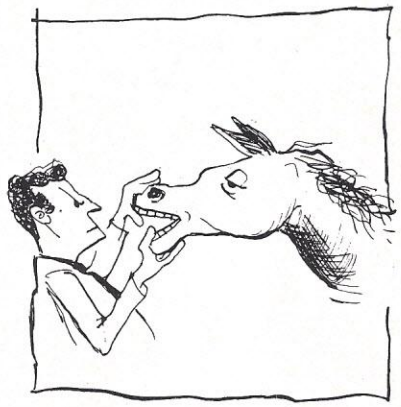
Paul Terrell of Byte Shop fame was one of the original manufacturer's reps for the Altair computer products. He received very early first hand knowledge of *Altair's* popularity. After learning of Dick Heiser's Arrowhead Computer Company and its success in Santa Monica, he opened his first Byte Shop in Northern California. Featured in a national business magazine (*Business Week,* July 12, 1976), Byte Inc. was flooded with inquiries about opening Byte Shops in other areas. At the time of this writing, he has fifty Byte Shops signed to a purchasing cooperative-type dealer arrangement and is now implementing a full franchise program. He has the lead in stores and the experience of what goes on in the retail end of microcomputers.

Altair Computer Center franchises are offered by MITS, Inc. through their subsidiary Altair Distribution Company Inc. MITS realized the computer outlet opportunity as a good way to give their customers all over the country the same excellent support and service on a local basis that is their trademark in customer relations. MITS obtained the services of Richard Brown, President of The Computer Store, Inc., a New England chain of stores and their largest MITS/Altair products dealer, to establish the Altair Computer Center program which would select, train, supply and support the network of uniformly professional stores. The initial activity took place in the Boston area and was recently moved to the MITS' Albuquerque headquarters for administration. Brown returned to his own retail operations while further expansion efforts are determined by the Pertec/MITS merger.

Computerland is headed up by Ed Faber, previously the National Sales Manager for IMS Associates, the Imsai computer outfit. Faber directed the marketing efforts which IMSAI claims resulted in two hundred twenty six "Imsai dealers" being set up around the country. No doubt many of these operate out of their garage or closet, but the numbers are very impressive never-the-less. These dealers are now buying direct from Imsai Manufacturing Corporation, a spin-off of the now-inactive IMS Associates. Much the same crew from IMS joined Faber in Computerland.

Even though there are several similarities, important differences exist among these three outfits. Each has a different view of retail computer outlets and their place in the market. I interviewed each of the franchisors and asked: "What makes a computer store a viable business?" The answers are revealing.

Computerland's Director of Franchise Sales, John Martin, had this to say: "People like to do it. In order for a business to be viable and run it has



to be serving and nurturing. As far as serving is concerned, I think that the demand out there is so great that programs like Computerland are forced into creation. That creates viability and its also extremely nurturing for the participants, both the Computerland people and the franchisees. It's a fun thing to do. It's not just that it's viable, it's also that it's fun. It does get the job done."

Paul Terrell responded to that question with: "A computer store or Byte Shop is a specialty-retail store. I look at the business and see it as a long-term specialty-retail business situation. It's a lot like CBS Pacific Stereo stores. They're specialty retail stores selling audio componentry, as opposed to department stores or mass merchandisors that sell what the trade calls 'brownware'. Brownware is the complete package of receiver, turntable and speakers in a self-contained, furniture-like unit. My analogy in our marketplace would be like video games or programmable video games will be 'brownware' to the home computer market. When the big manufacturers move in, the Byte Shops are going to be attachment stores, selling to a sophisticated home computerist who knows what floppydisks or line printers are and wants them. There will be a continuing need for education, service and hand-holding in this marketplace just the same as when ham radio led to hi-fi which led to Pacific Stereo-type stores for the consumer. It's a viable business because it's specialty retailing."

MITS is in the grips of change because of the Pertec merger. The person at MITS now directing the marketing efforts is Mr. Bob Chisum, a Pertec employee with lots of savvy and broad marketing background. He declined comment at this time.

Ryal Poppa, the Pertec President, was emphatic about the future of MITS outlets and the expansion of that network in a recent interview though (SCCS Interface, Jan. 77).

Richard Brown of The Computer Store, Inc., the creative force in the Altair Computer Center program start-up made these comments about that question. "The viability of a computer store is dependent upon the same things as any other business: profits. The ability of a retail store to serve various classes of computer users is proven. The Computer Store, Inc. is a very good example. The types of computer users we sell to are mostly ignored by the large mini and maxi computer manufacturers because of the costs of selling to these customers. Those large companies have direct costs which prohibit their selling onesy-twosy on these comparatively low-cost computers and peripherals. A retail outlet can satisfy those onesy-twosy customer's needs, but it too must make an acceptable profit on its goods and services. We won't stock a product that we can't make money on. If enough store owners feel that way, the suppliers to the personal computer market must provide better margins to stores to get sufficient exposure and sales.

The viability of retail computer stores is dependent also upon the good business judgement of both the suppliers and the store owners. Supplier's dealer discount structures which strangle profits will not benefit either party and store owners must go to more experienced and reasonable sources to uphold their businesses".

As you can see, while the business programs are much the same, there are important differences. To find out what this means to you, the prospec-

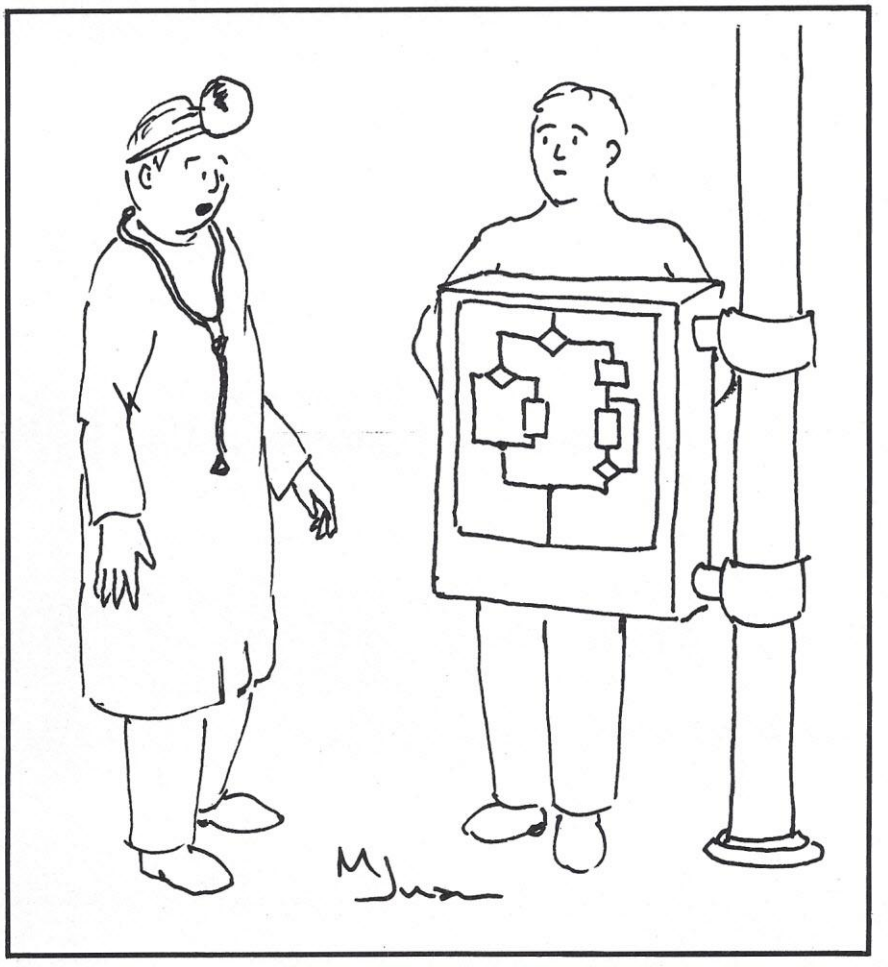
tive computer store owner, you must ask questions and *question the answers.* Do your own research. Compare what you've learned with what the franchisors have to say. This is important. One of the franchise companies provides a reprint from a widely-read computer weekly which describes a report by a New England-based electronics consulting firm on the home computer market's growth over the next several years. Well, the fellow who prepared the report admits that on closer examination, his numbers are all wrong. He took a lot of manufacturers at their word without examining the hidden meaning in any of the statistics the companies offered up. Another fellow, well respected for his savvy and foresight in this industry took a long look at the numbers for several of the microcomputer makers and determined by dividing the average system selling price into the gross sales that the number of units sold is likely to actually be one-third to one-half of the numbers claimed.

Does this mean that the "personal computer market" is not all it's cracked up to be? Probably not. (The 12,755 attendees at a recent personal computing show in San Francisco certainly says something about that). It does point out, though, the real need to ask questions and then question the answers.

Don't compromise in your investigation. Compromise is the block on which you rest your head when the LOP factor enters sharpening its axe.

This suggested outline for the investigation of the business of owning a computer store is incomplete. It can't be all-encompassing because of the nature of the beast. There are hundreds of very specific books on new business start-ups, myriads of details to consider before you go ahead. Some good consultants are available . . . at a price. The U.S. Government Small Business Administration and the Department of Commerce both have extensive amounts of information available to the would-be entrepeneur. Libraries, trade associations, suppliers, seminars, universities, bank newsletters and trade journals should be sifted carefully for pertinent information. All states in which each franchisor is required by law to disclose fully everything about its offer have public agencies eager to help prospective franchisees with information from their files about the franchisor.

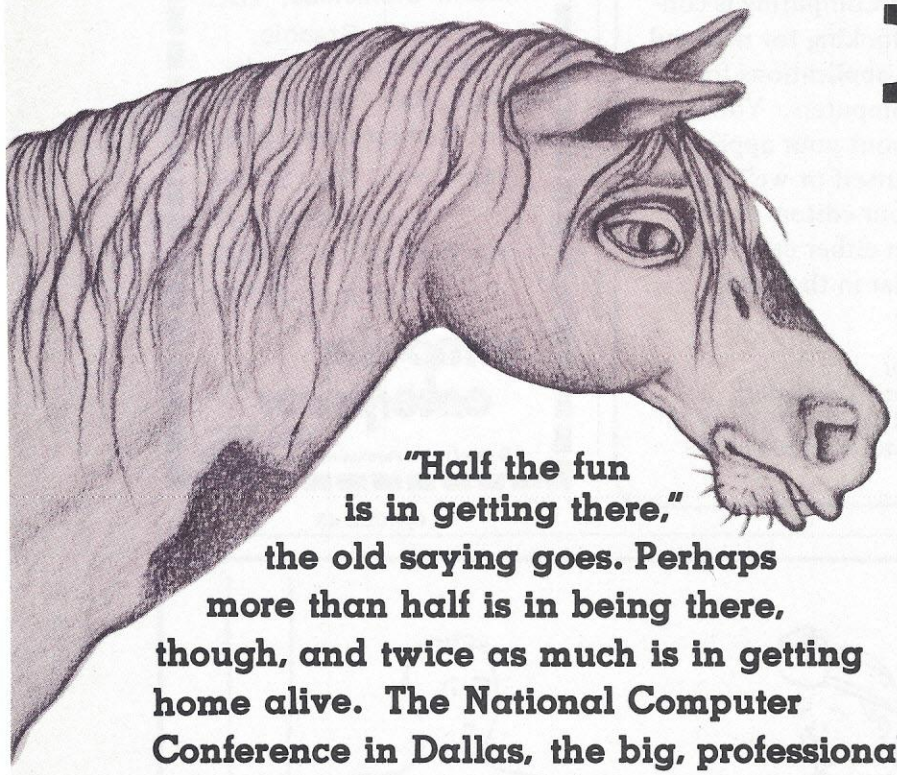
Do your homework. Do a helluva lot of legwork. A $100 phone bill is peanuts compared to a $100,000 investment. ■



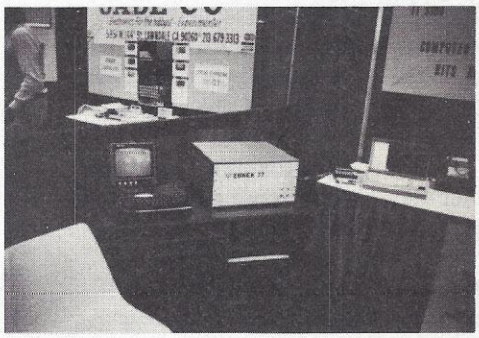
goodbye old paint

WE'RE A-LEAVIN' BIG D

by Henry Gilroy



"Half the fun is in getting there," the old saying goes. Perhaps more than half is in being there, though, and twice as much is in getting home alive. The National Computer Conference in Dallas, the big, professional computer gathering of the year, was carried off very handsomely in June. As the pictures suggest, even a big show looks very much like a small one. It was great for the participants, stimulating, informative. For the first time, NCC featured a Personal Computing Section lending a heightened sense of importance and respectability to the laughing and scuffling promoters of this brave new field . . . then back to the real world of too much work . . .

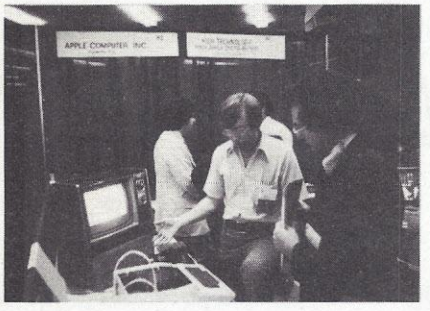


The new EBNEK system (yes, the proprietor's first name is Kenbe) is among the first to use a 16-bit microprocessor in the personal computing field. That must bring cheer to the ever-present JADE CO in the next booth, since the 16-bit systems will create a hungry new market for JADE components.

Ron Scales of MITS seems not unduly excited by all the gurgling and squirting in the Process Control System under Altair's influence behind him.

Photographs by Charles Floto

When a big show like the National Computer Conference ends, one of the better spectator sports consists of watching the attendees leave town. Those bright, natty, alert, aggressive folks who flowed into town four or five short days earlier, now slope out of town, hollow-eyed, headachy and stupid with exhaustion. Sic transit gloria mundi.



The fellows are staring into the witty new APPLE II, shown with its lid off.

Heading back to Albuquerque on a hot, humid Texas evening, the party from PERSONAL COMPUTING fell in with a gang from Microsoft. A couple of MITs folk were also in the crowd waiting for the Texas International DC-9; there was some morbid discussion about how large a percentage of the tiny personal computing business would be lost in a single event if the plane happened to go down.

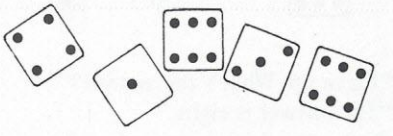
As a matter of fact, Texas International was having mechanical difficulties with its aircraft, and a long delay developed while the airline changed gates a couple of times and cheered up passengers with announcements of still longer waits. (One school of thought, to which many of us certified groundlovers subscribe is that we're happy to wait, thank you. You work on that airplane until you're perfectly satisfied; we'll entertain ourselves somehow.) After you've run out of gossip, time does hang heavy.

Luckily, an ideal distraction for computer types was available . . . and it proved *so* distracting that it seems worthwhile to pass it along here in print for the encouragement of nationwide frustration. The activity isn't really new, and a version of it appeared recently in a slightly different form in a computer newsletter, but before it's spoiled by common use, consider this fairly elegant treatment.

The name of the game is Petals Around the Rose, and that name is significant. Newcomers to the game can be told that much. They can also be told that every answer is an even number. They can be told the answer for every throw of the dice that are used in the game. And that's all the information they get.

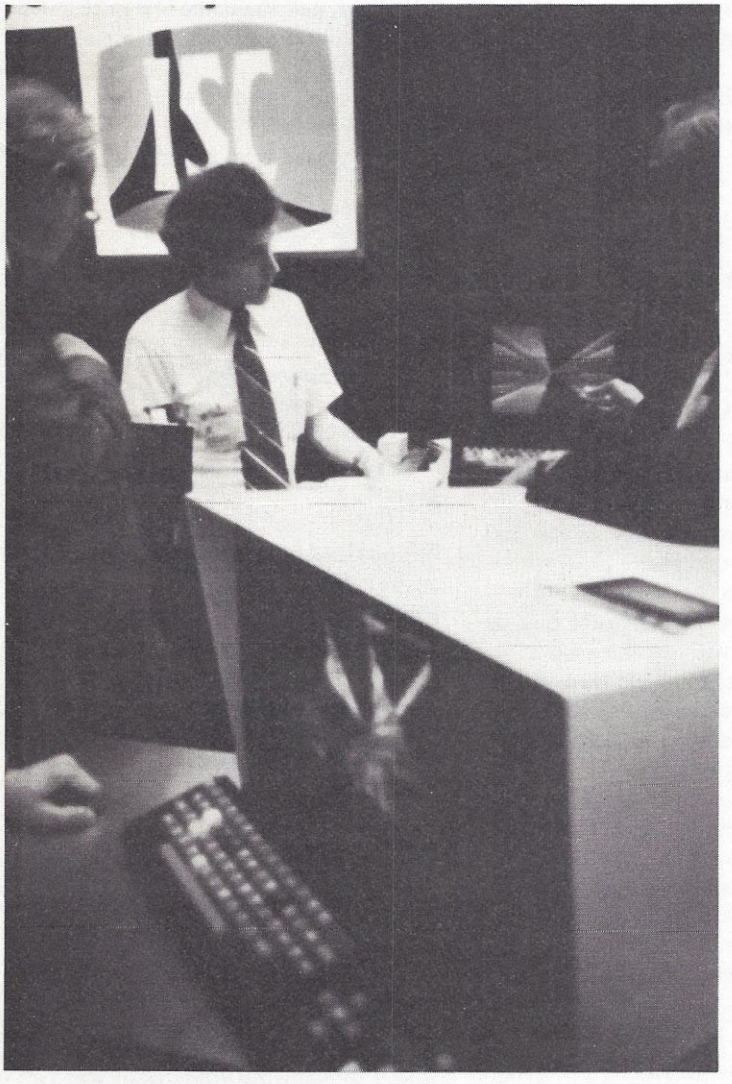
The Potentate of the Rose, the guy who has the dice and knows the game, rolls five dice (which can be swiped from the family Yahtzee set if necessary), and remarks almost instantly on the answer. For example: in Roll #1 the answer is two.

Roll #1.

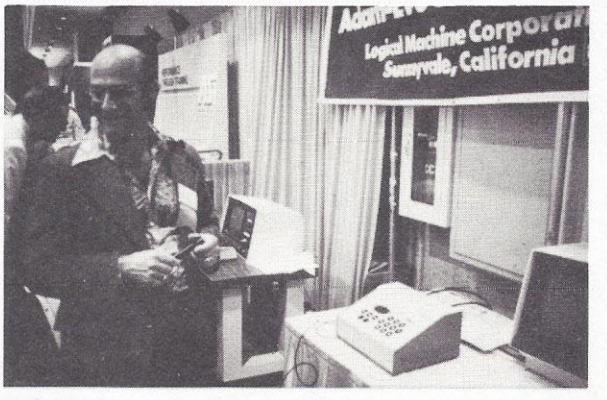


"The answer is what?" says the new player.

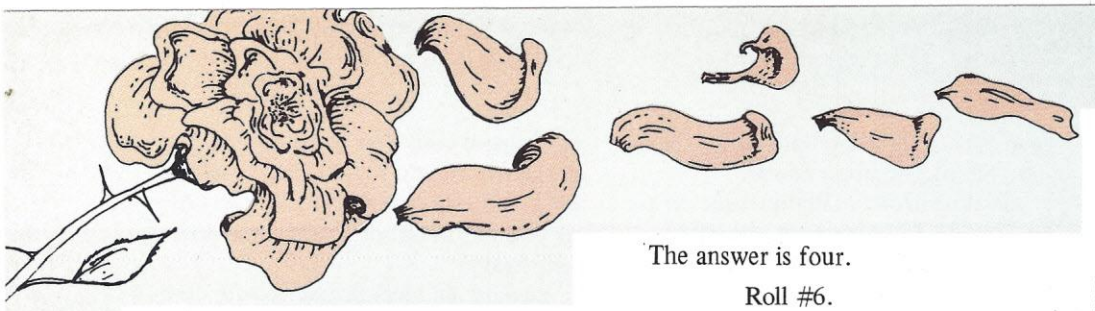
"Two."



ISC's elegant color displays always grab the passerby, who tends to stand transfixed while the other features of the Compucolor and its brethren are explained in detail.



If you take the microphone away from Carl Berney, you can teach that yellow-faced box on the table to understand sixteen words or short phrases so it lights up when you speak to it. Creepy, but fascinating . . . not Carl, the machine.



"On that roll?"

"Yes."

"Would it still be two if I moved the dice without turning any of them over, just rearranging the pattern?"

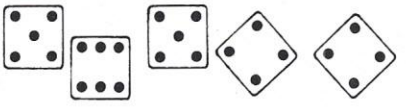
"I can tell you only three things: the name of the game, the fact that the answer is always even, and the answer for any particular throw. In this case, the answer is two."

"So that's how it is. What am I supposed to do?"

"You're supposed to tell me the answer before I tell you. I'll give you all the time you want, but don't tell me your theory, *just the answer.* If you figure it out, you don't want to give the idea away to these other jokers around you. Make them work for the answers, too. If you get the answer right on six successive rolls, I'll take that as *prima facie* evidence that you understand the game."

"OK, roll again."

Roll #2.

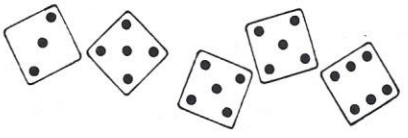


"I give up. What's the answer?"

"The answer is eight."

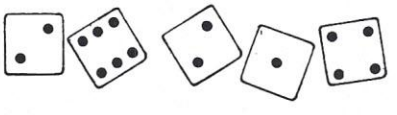
Again.

Roll #3.



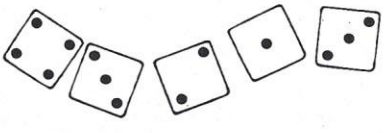
The answer is fourteen.

Roll #4.



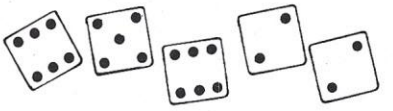
The answer is zero.

Roll #5.



The answer is four.

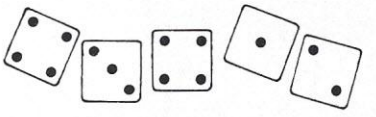
Roll #6.



The answer is four again.

By this time – it's a warm night at the Dallas Airport – half a dozen people, friends and strangers, are sitting on the floor around the Potentate of the Rose, snorting and guffawing in disgust while guessing consistently wrong on the answers. The Dallas airport is a dandy place for the purpose, because the floor is carpeted, at least in the TI waiting area, and the dice don't bounce twenty feet when thrown. Security types stop occasionally to give steely glances at the proceedings, and waiting strangers stop reading to listen to the discussion. Some blush at the language.

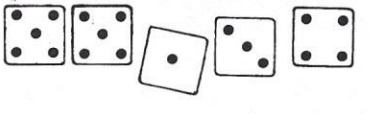
Roll #7.



The answer is two.

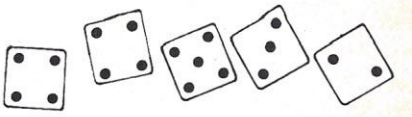
Some people, like PERSONAL COMPUTING's Marketing Coordinator, Louise, catch on in half a dozen rolls, shrugging the whole thing off as trivial. Mark James, the Seer of COMEX at USC (who gave us this game in the first place), observes that many brilliant, learned folk who visit their establishment and subject themselves to this, depart hours later without the answer. Many draw sketches of the throws and carry the sketches off to laboratories for study among the boiling cauldrons and croaking ravens. Weeks later, they may call Comex with proposed answers based on elaborate (and expensive) computer analyses of the game. The answers proposed are more often wrong than right. Petals Around the Rose may be almost as great a drag on the national economy as Startrek.

Roll #8.



The answer is ten.

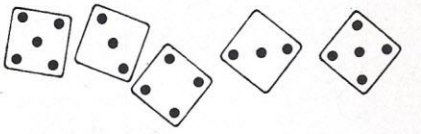
Roll #9.



The answer is six.

"Six? It can't be!"

Roll #10.



The answer is twelve.

"Well, that shoots my last three algorithms! Gimme a piece of paper so I can work on this. Let me list everything. The name of the game is Petals Around the Rose?"

"Right, and the name is significant."

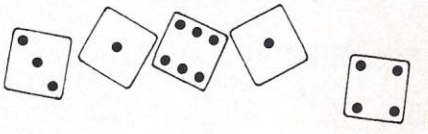
"OK, and the answer is always even."

"Correct."

"Can I roll the dice myself or do you have to do it?"

"Oh, you're welcome to roll them."

Roll #11.



"Is the answer eight?"

"No, it's two."

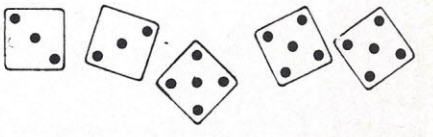
"Oh hell!"

"No, that's the answer in another game."

"Well, it can't be very complicated or you wouldn't be able to spit out the answers so fast. You spend ten minutes trying to figure out the tip and count your change at breakfast."

"That's me, all right, but I am mystically suited to this game of Petals Around the Rose. Every man has some talent, and this is mine."

Roll #12.



The answer is sixteen.

"Wait, we haven't gone that high before. I thought the upper limit was 12."

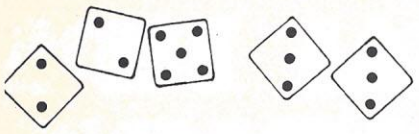
"No, we had a fourteen before."

"Oh yeah. How high can it go?"

"I can tell you three things . . . "

"Aw, shut up and roll!"

Roll #13.



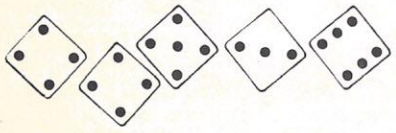
The answer is eight.

Steve Wood caught on while we were still in the waiting area at the airport, but the others stayed puzzled until we got on the plane. After takeoff, it was possible to throw the dice on a fold-down table while leaning over the back of a seat. Seven or so people watched without too much trouble. Rick Weiland caught on after another half hour. Paul Allen's neck got stiff fairly soon and he gave up to read his book. Mark McDonald and Bill Gates hung on grimly.

Funny thing about Bill, he began to get answers right, but not consistently. He admitted that he was remembering throws he'd seen before, along with the answers, but he had no plausible theory to account for answers. Remembering?

"Oh, sure," said the rememberer. "Like this throw. . . "

Roll #14.



The answer is six.

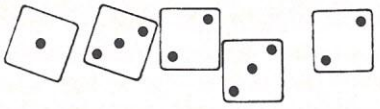
. . . it's just like a roll we saw earlier (Roll #9), except that the six this time was a two last time. I don't know why the answer is the same, but it is."

The rotten kid must have had two dozen rolls, with answers, committed to memory by the time this discussion came up. ("Kid," because he ordered a Shirley Temple at lunch one day just a few months ago, and drank it before the awestricken eyes of his tablemates, some of whom realized that they were at least twice Bill's age. He has taken leave of his undergraduate courses at Harvard to lead this little company, Microsoft, which is creating BASIC and FORTRAN, etc. . . interpreters and compilers for various microcomputers. No applications software in their product line yet, just system packages that are already making them famous and may at length make them rich. *Sigh.*)

"I think I'd better use a piece of paper," said Bill, who was by this time the only active player who still failed to divine the secret. Here is part of his scratch sheet. The fine programming mind at work.

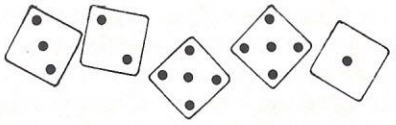
"Aha," said he after about an hour and a half of this foolishness. "The answer is four on this roll."

Roll #15.



"Yes."

Roll #16.



"And the answer to this is ten."

He was right again, and he rattled off the next dozen answers without a quiver, declaring that he wasn't just remembering history now, but knew what was going on. Like the others, he didn't feel cheated by the game, but was satisfied that his effort paid off.

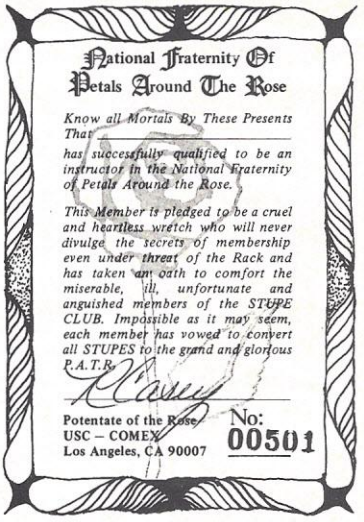
Actually, when you go through this at COMEX and finally get the answer, a committee forces you to kneel in the middle of the floor so you can be sworn in as a Potentate of the Rose while somebody taps you on the shoulders with a piece of wood. (Certain people tend to be kissed during the process. I was struck smartly with a blackboard pointer.) COMEX even hands out a nice printed card. We didn't try all this on the airplane.

Picture of card

This is a good game for implementation on a computer system. Mark has it up on the 370 in Fortran at USC and the throws of the dice are printed out satisfactorily on their DECwriter terminal. Not bad. Probably would be better on a CRT terminal with decent graphics and a mechanism for displaying the dice in non-linear patterns that seem more natural than the stiff matrix practical on a teletypewriter. Should be good stuff for the Commodore PET (which happens, like the OSI 6502 system, and the Altair 8080 systems, to use Microsoft BASIC) when it gets to market.

The game does work well with real dice. COMEX reports that one major convention was largely disrupted when they arranged for the gift shop at the hotel to stock a large supply of dice, then introduced Petals Around the Rose to many conference attendees. "It was amazing," says Mark, "distinguished-looking ladies and gentlemen in neat business clothes could be seen crawling on their hands and knees in little groups all over the hotel. While speakers were saying important things on lecture platforms, the rattle of dice and mutterings about answers almost drowned them out from all over the dimly lit halls. We don't like to do this too often. Makes enemies."

Even the Microsoft guys agreed that Petals Around the Rose offers a good excuse for doing a bit of applications


National Fraternity Of
Petals Around The Rose

Know all Mortals By These Presents That

has successfully qualified to be an instructor in the National Fraternity of Petals Around the Rose.

This Member is pledged to be a cruel and heartless wretch who will never divulge the secrets of membership even under threat of the Rack and has taken an oath to comfort the miserable, ill, unfortunate and anguished members of the STUPE CLUB. Impossible as it may seem, each member has vowed to convert all STUPES to the grand and glorious P.A.T.R.

Potentate of the Rose
USC – COMEX
Los Angeles, CA 90007

No: 00501

software. Indeed, Bill scratched out a program for the game on a napkin and passed it over the seat so that it could see daylight in PERSONAL COMPUTING.

We won't, of course, because it gives away the game. Figure it out and write the program yourself.

However, we'll give you one line of Bill's program as it is written in pencil on the napkin (which is safe in our vault for evidence). Bill's written program makes us feel much better about dealing with a smart guy who can not only program, but can remember all those throws of the dice. Things do even out. The line reads:

PRINT "THE NAME OF THE GAME IS PEDAL AROUND THE ROSES"

No wonder he was having trouble.

Yes, the plane made it. The industry survives, and the spectators seemed to enjoy the show. ■

PROFESSIONAL TIPS ON CASSETTE HANDLING

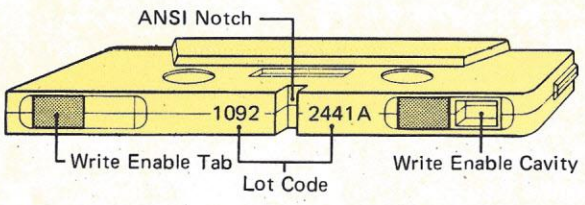
Tape cassettes are now so common and familiar that they are taken wholly for granted, and that's not necessarily a good thing if the cassette user expects to write digital data on the tape, store it and retrieve it reliably. The reliable tape cassette is a remarkable example of highly developed technology, as anyone who remembers unreliable early cassettes will attest.

To maintain good performance, cassettes need careful handling, inspection and routine service. The concerns in this case are mechanical, quite distinct from problems associated with the tape itself and from the electronic aspects of tape recording. PERSONAL COMPUTING's professional sister publication, DIGITAL DESIGN, recently published a commentary on cassettes authored by Bob Katzive of Information Terminals Corp., Sunnyvale, CA 94086. These excerpts may be useful and interesting in purely personal computing.

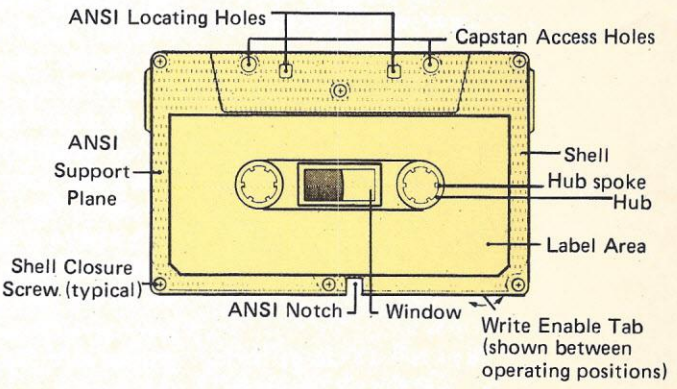
ANATOMY OF A CASSETTE

To develop the vocabulary necessary to have a dialog with knowledgeable cassette users, the following series of annotated drawings will be helpful.

Digital Cassette: Bottom View



Digital Cassette: Front View



definition of terms

ANSI Locating Holes:	Holes fit over locating pins in drive to position cassette relative to head.
ANSI Notch:	Designates ANSI Standard Digital Cassette. Off center position useful in depicting which side is up.
ANSI Support Plane:	Flat plane along which cassette must be supported with minimum rocking.
Bridge and Tape Guides:	Reinforcement of monolithic bridge provides stability and deformation resistance to critical dimensions in head cavity area.
Capstan Access Holes:	Holes for capstan to fit into on capstan-type drives.
Head Cavity:	Head penetrates into cassette to reach tape in this area.
Hub:	High precision cylindrical surface on which tape pack is wound. Dimensions are critical.
Hub/Leader Lock:	Place where tape and/or leader is attached to hub.
Hub Spoke:	High precision projections mate with drive spindle for minimum whiplash.
Label Area:	Depressed area where label may be placed without rising above ANSI support plane.
Lot Code:	Number identifies lot this cassette is from.
Pressure Pad:	Pushes tape against head to provide good read/write performance. Pad size, material, and pressure are critical performance parameters.
Pressure Pad Spring:	Metal spring applies consistent, non-fatiguing force for pressure pad action.
Roller:	Rotating Delrin tape guide provides smooth tape motion. Must be highly cylindrical to avoid jitter.

GETTING THE MOST FROM YOUR CASSETTES

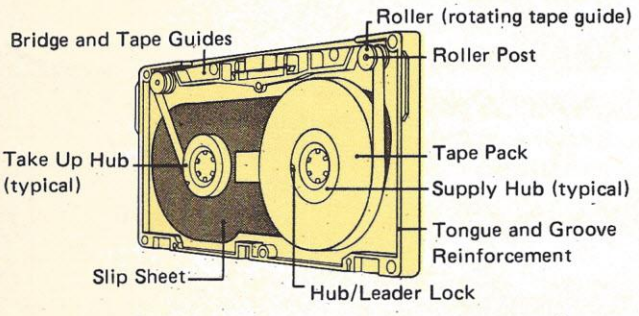
Digital tape cassettes are designed to provide optimum service and extended life when used in data storage applications. They are precision devices, built to more exacting specification than cassettes used in audio equipment. Reasonable care in handling and storage lengthens the service life of cassettes. These factors are of critical importance.

handling and storage

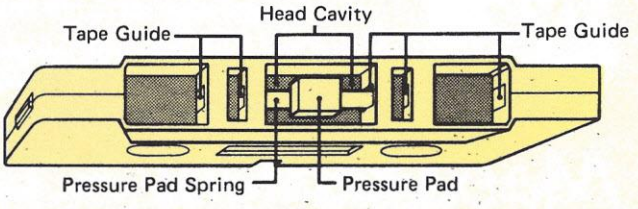
- Keep the cassette at least three inches from equipment that generates magnetic fields, such as motors, fluorescent lamps, transformers, etc.
- Keep cassette out of direct sunlight; do not allow its temperature to be changed suddenly over large ranges because this can distort tightly wound tape.
- Store the cassette in its box when not in use. Keep it in a dust and lint-free environment.
- Avoid touching the tape surface; fingerprints contain oils that attract dust and other substances that damage tape.
- Remove tape from tape transport only after it has been rewound.
- Avoid dropping the cassette or subjecting it to sharp shocks that may damage the precision bearings. Normal handling should not cause any difficulties.
- Protect the tape cassette and tape transport from tobacco ash and smoke.
- Never remove the tape from the cassette.
- Examine incoming cassettes for signs of shipping damage. Don't use units suspected of being damaged.
- Neutralize possible mistreatment in shipment by rewinding each tape twice before using it the first time. Wind it all the way forward once, then all the way back. Use a tape transport to do this – do not attempt it manually.
- Store in conditions approximating temperature and humidity conditions in area of use.
- Use pressure sensitive labels with nontransferable adhesive if you are mounting your own labels. Avoid embossed plastic labels; they tend to shed fine particles that can cause contamination.
- Periodic adjustment to the tape transport not only extends tape cassette life, but also helps to keep your entire system working to specification, which will help avoid loss of data. Follow the transport manufacturer's recommendations for periodic preventative maintenance.

Following the simple, common sense suggestions above, will give you the best possible service from your cassette.

Digital Cassette: Opened View



Digital Cassette: Top View (Tape Removed)



Roller Post:	Axis upon which roller turns. Must be exactly perpendicular to avoid skewing the tape or forcing it to one side.
Shell:	The outer enclosure of the cassette must be molded precisely to meet ANSI specification. Must withstand abuse; should be rigid to prevent warp and skew.
Shell Closure Screws:	Make shell a rigid package, but permit opening of cassette for in-process inspection.
Slip Sheet:	Low friction liner reduces tape pack abrasion.
Supply Hub:	The hub from which tape is being drawn while the cassette is operating. (Either hub can be the supply hub, depending upon direction of tape travel.)
Take Up Hub:	The hub onto which tape is being moved when the cassette is in operation.
Tape Guides:	High precision, perpendicular guides control tape path, limit skew.
Tape Pack:	Generic term for the rolled up tape on the hub. Pack winding must be tightly controlled to avoid stepping (projecting tape edges subject to abrasion).
Tongue and Groove Reinforcement:	Provides extra warp resistance to shells when assembled. Also helps keep dust from infiltrating into cracks.
Window:	Provides method of checking tape location; ultrasonic welds keep it firmly attached to shell on all edges to keep dust out. ITC never glues windows in.
Write Enable Cavity:	This cavity is exposed to permit entry of cassette drive write enable detection probes.
Write Enable Tab:	Tab flips over to permit data written on tape to be protected. When covering the write protect hole, the drive is enabled for writing on the tape.

Classifieds

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Personal Computing

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The primary motive for purchasing any home appliance from a refrigerator to a stereo is the perception of need. Whether or not this perception is real is immaterial. People buy stereo equipment because they see needs beyond the need to listen to music. They need stereos because they need more control and better quality than a radio gives them, because their friends have stereos, because they want to keep up with popular music, etc.

It would seem logical to me that before the home computer can become a common household reality, a need will have to be established for it. The average person doesn't need an $1,800 computer that he can learn to program (with considerable time and effort) to figure his income taxes. H & R Block and a host of accountants are at his service to figure the whole thing out at a small fraction of this price.

Establishing this perception of need in the average household is going to require first the proven application of the computer to home budgeting, home education, home record keeping, home energy management, and many others. People will buy computers in massive quantities when they realize that they can easily use them to organize the business of their personal lives.

We picture the PET computer on the cover of this issue because it represents the first significant push into a mass consumer market for personal computers. It is true that the average home computer user isn't going to have the patience to learn BASIC, but several hundred thousand Americans have already learned or are learning the language in schools.

The hope is this: give a PET type computer to every person who knows how to program BASIC and they will blaze a software trail right into the American home. They will write millions of programs that tomorrow's home computer user can simply plug into his computer and modify to his own needs without knowing a thing about programming.

With Heath, Radio Shack, General Instrument, APF and others also announcing their imminent entry into the personal computing market, it is safe to say the test of a mass personal computing market will come soon.

The Last Word

The October Midwest Personal Computing Show in Chicago is shaping up to be one of the largest and most interesting personal computing events to date. Most facinating to me is the broad scope of exhibitors from toy manufacturers to semicondutor compaines, video game companies, computer retailers, book publishers, minicomputer manufacturers, electronic retailers, etc.

Among the expected newcomers are Atari, Mattel, Radio Shack, Data General, Texas Instruments, Harris and Bell and Howell. As personal computing grows it is becoming a market for a strange mixture of competitors.

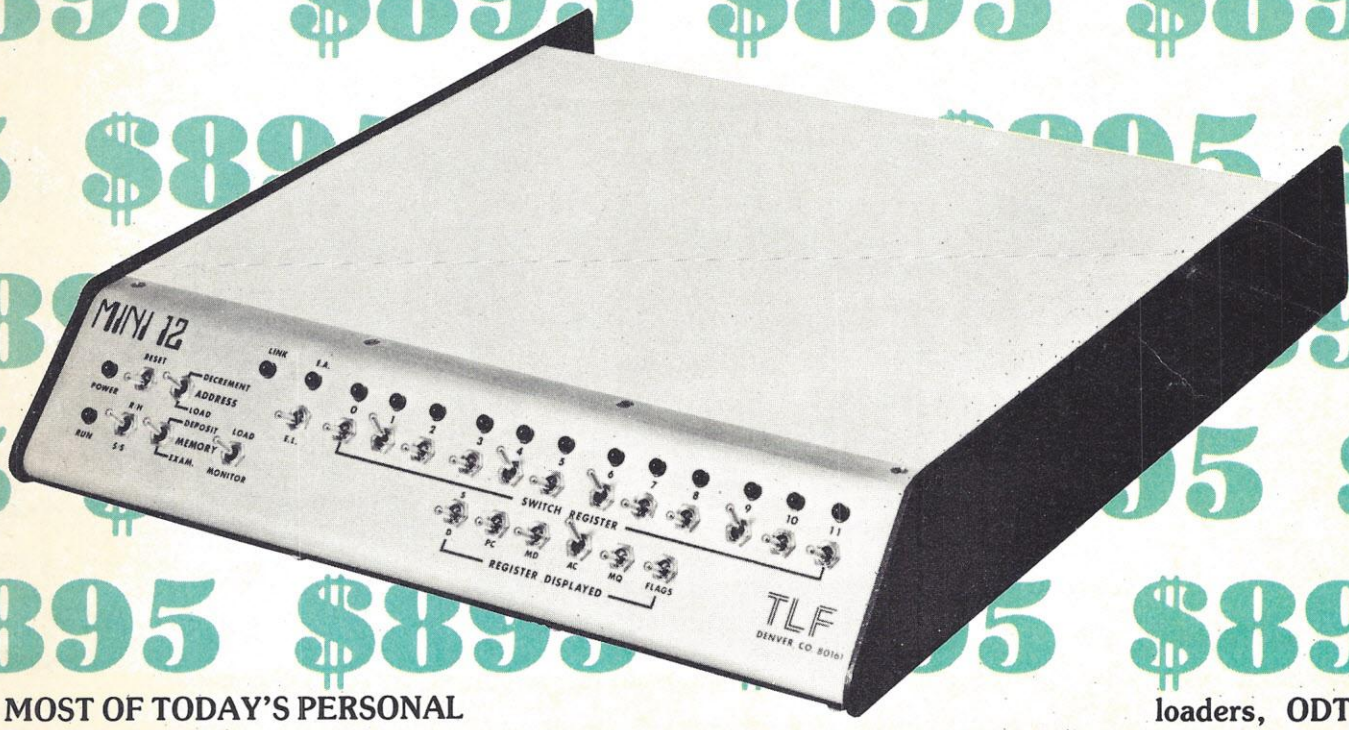
Commodore will be there with the PET and it will be interesting to see if they can be upstaged by Radio Shack or Apple Computer. Mits, which put on one of the most professional (and interesting) displays at the NCC in Dallas, will be in Chicago with its newest business system. They have definitely positioned themselves in the low end of the small business market and we hear rumors of great things to come now that the company has become a division of Pertec Computer Corporation.

As always, it is surprising to see how fast this field develops. Hope to see many of you in Chicago.

David Bunnell

Publisher

Why buy a micro, when you can buy a mini for less!



MOST OF TODAY'S PERSONAL COMPUTERS are microcomputers. Compared to our minicomputer they are slow and expensive.

Our mini "the MINI 12™" has been around for three years. We've been steadily selling it to industrial customers who have proven its reliability. Only recently have we paid much attention to the personal computing market. We've discovered that our computer is simply better, and most interestingly, LESS EXPENSIVE.

NONE OF THE MICROCOMPUTERS can offer you the range of software available to the MINI 12. Compatibility with the most popular minicomputer, DEC's PDP-8E, gives you a vast library of programs. You will also be pleasantly surprised when you experience the speed and sophistication of our EXTENDED BASIC compiler, or FORTRAN, ALGOL and FOCAL.

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The MINI 12 comes with 8K of memory and is easily expandable to 32K. Because the MINI 12 processes 12 bit words (instead of 8 bit bytes) you need far less memory. For most applications... using our optional MINI STORE digital cassette system with the BASIC compiler, you will never need add another single byte!

Because we want you to have the pleasure of using your minicomputer right away, our MINI 12 comes fully assembled, debugged and ready to plug in. It includes a full front panel, controller for eight digital tape drives, and built-in serial interface plus other technical niceties like a binary loader and monitor bootstrap in ROM memory.

Frankly, when compared with microcomputers, we're surprised at how good a deal we are. Write... or better yet, give us a call @303-794-1634 and let us help you get it all together!

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CIRCLE 2

SWTPC announces first dual minifloppy kit under $1,000

Now SWTPC offers complete best-buy computer system with $995 dual minifloppy, $500 video terminal/monitor, $395 4K computer.

$995 MF-68 Dual Minifloppy
You need dual drives to get full benefits from a minifloppy. So we waited to offer a floppy until we could give you a dependable dual system at the right price.

The MF-68 is a complete top-quality minifloppy for your SWTPC Computer. The kit has controller, chassis, cover, power supply, cables, assembly instructions, two highly reliable Shugart drives, and a diskette with the Floppy Disk Operating System (FDOS) and disk BASIC. (A floppy is no better than its operating system, and the MF-68 has one of the best available.) An optional $850 MF-6X kit expands the system to four drives.

$500 Terminal/Monitor
The CT-64 terminal kit offers these premium features: 64-character lines, upper/lower case letters, switchable control character printing, word highlighting, full cursor control, 110-1200 Baud serial interface, and many others. Separately the CT-64 is $325, the 12 MHz CT-VM monitor $175.

$395 4K 6800 Computer
The SWTPC 6800 comes complete with 4K memory, serial interface, power supply, chassis, famous Motorola MIKBUG® mini-operating system in read-only memory (ROM), and the most complete documentation with any computer kit. Our growing software library includes 4K and 8K BASIC (cassettes $4.95 and $9.95; paper tape $10.00 and $20.00). Extra memory, $100/4K or $250/8K.

Other SWTPC peripherals include $250 PR-40 Alphanumeric Line Printer (40 characters/line, 5 x 7 dot matrix, 75 line/minute speed, compatible with our 6800 computer and MITS/IMSAI); $79.50 AC-30 Cassette Interface System (writes/reads Kansas City standard tapes, controls two recorders, usable with other computers); and other peripherals now and to come.

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CIRCLE 3